VOLUME 84, No. 10

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

# POWER

N. O. WYNKOOP
*Publisher*

*Associate Editors*
F. A. ANNETT
S. A. TUCKER

*Consulting Editor*
E. J. TANGERMAN

PHILIP W. SWAIN
*Editor*

*Associate Editors*
B. E. SAWYER
L. N. ROWLEY

PAUL WOOTON, *Washington* G. C. TENNEY, *San Francisco* H.S. KNOWLTON, *Boston*

## OCTOBER, 1940

Model tests solve high-pressure-steam piping problems... 58
Steam-engine-driven air compressor takes small space.... 62
Power-factor improvement with synchronous motors..... 64
Indiana Harbor has 100% makeup at 825 lb, 750 F..... 67
How to figure diesel waste-heat-recovery possibilities.... 70
Practical data on modern unit heaters—Part I..... 72
New boiler with no outage at Toledo pumping station... 75
Pointers on industrial power problems by R A Langworthy 78
How Safe Harbor hydro plant meters water flow—Part I. 80
Southern Bleachery saves 5520 tons of coal per year... 83
Versatility keynote of new central station heat balances.. 84
Stub tubes keep boilers working in emergencies..... 88
Guntersville, 5th in TVA hydro chain—photostory..... 89
Ultra-modern power services at Bankers Life Bldg..... 93
Lubricating cylinders of superheated-steam engines.... 114
Safe lighting units for inspecting boiler interiors..... 118
Power engineers hold annual meeting at Columbus, Ohio 120

THE OPERATING ENGINEER

Clean-cut design, good operation at Hartford laundry.. 97
How many draft gages and where—third of a series.... 100
Feedwater Connection.. 99 Practical Aids ..... 102
Readers' Problems..... 106 How to Weld..... 110

OTHER DEPARTMENTS

Speaking of Power..... 96 New Plant Equipment... 124
Data Sheet No. 99..... 128 George Edwards ..... 132

A McGRAW-HILL PUBLICATION

Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N.Y.

JAMES H. McGRAW, Founder and Honorary Chairman

JAMES H. McGRAW, JR., President — HOWARD EHRLICH, Executive Vice-President — MASON BRITTON, Vice-Chairman
B. R. PUTNAM, Treasurer — D. C. McGRAW, Secretary — J. E. BLACKBURN, JR., Director of Circulation

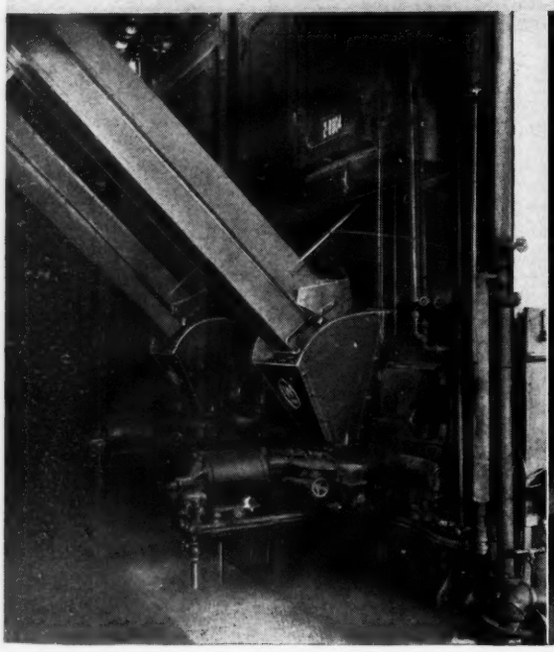
CHICAGO, 520 North Michigan Ave. DETROIT, 2-144 General Motors Bldg.
SAN FRANCISCO, 68 Post St. ST. LOUIS, 455 Paul Brown Bldg.
WASHINGTON, National Press Bldg. BOSTON, 1427 Statler Bldg.
PHILADELPHIA, 16 South Broad St. ATLANTA, 1011 Rhodes Haverty Bldg.
CLEVELAND, 1510 Hanna Bldg. LONDON, Aldwych House, Aldwych, London, W C.2

Copyright, 1940, by McGraw-Hill Publishing Company, Inc.

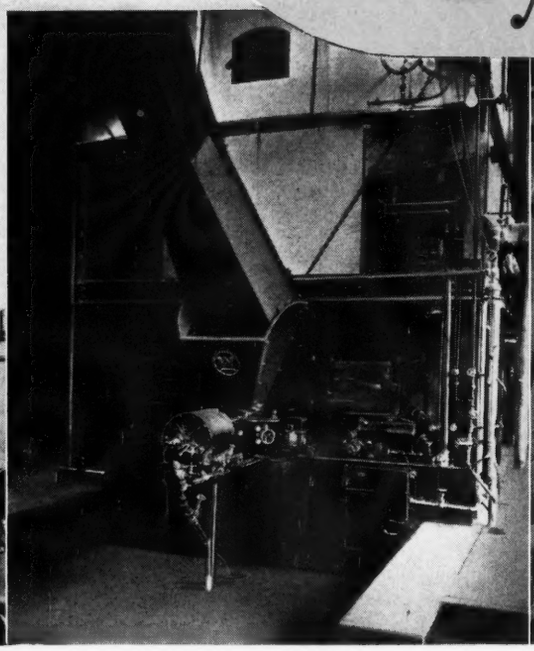
POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

ADVERTISING PAGES REMOVED

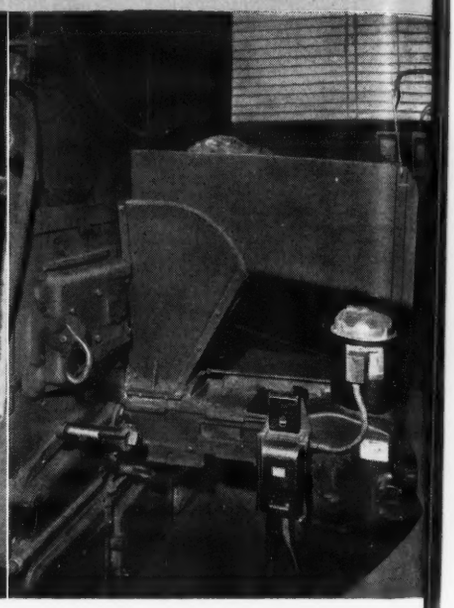
# IN PLANTS LIKE THESE FUEL By Records



Single Retort Stokers in Brooklyn, New York, plant of Bemis Bag Company are responsible for large savings.



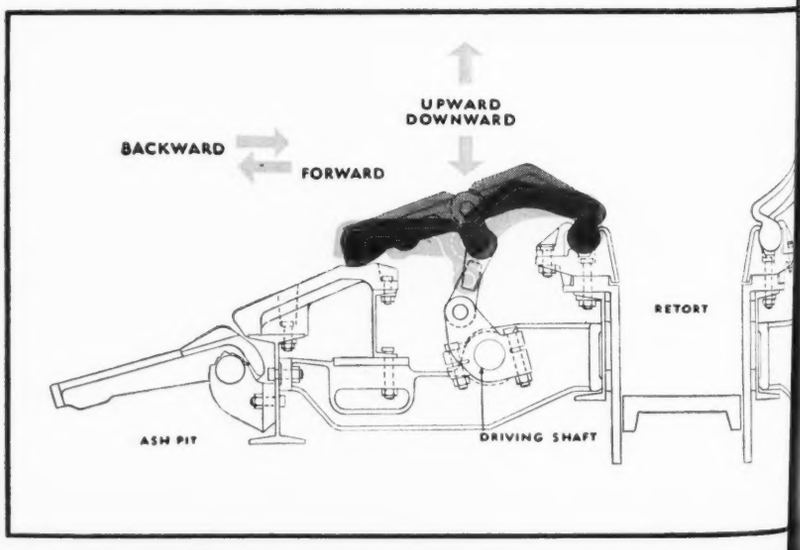
New Phoenix Hotel, Lexington, Ky., says, "Stoker meets every demand of variable hotel steam needs."



"Satisfactory economy on coal . . . maintenance expense in 3 years," repor Lewis Laundry, Louisville.

## THESE BENEFITS RESULT FROM THE LINK-GRATE PRINCIPLE

Link-Grate Motion gives the entire fuel bed both up-and-down, and forward-and-backward motion. Direct results are a constantly agitated fuel bed, cool grates, correct air flow and elimination of troublesome clinkers. You can burn less coal, or cheaper coal, often with increased efficiency.




# Westinghouse

# CHALLENGE TO INDUSTRY'S PATRIOTISM

## *Calls for Plain Speaking*

IT is a pity that the greatest national defense effort in American history had to be made during a presidential election campaign. For a modern defense effort involves an intensely practical industrial project, while an election campaign involves an intensely emotional political propaganda. And those two don't mix.

That, as I see it, is the chief reason for the welter of claims and denials, charges and counter-charges that have been getting in the way of contracts for planes, tanks, guns and all the rest of the armament for which the American people are so nervously peering down the road.

We are told that the managers of industry, smarting and suspicious under the repeated attacks of government officials for some years back, have been reluctant to assume the abnormal risks of defense contracts without commensurate safeguards, and that the politicians who must authorize those safeguards have been reluctant to do anything that might be construed as letting down the bars for unscrupulous business men to exploit the national emergency. For the one, the business risks of full speed ahead have been too great; for the other, the political risks of full speed ahead have been too great. So we don't go full speed ahead.

This is not written to increase that clamor of recrimination on either side. On the contrary, it is an appeal for some decent and thoughtful consideration on the part of all concerned—consideration for the urgent needs of the nation, for the problems and responsibilities of both the politicians and the industrialists, for the elementary principles of prudent business management, and for the good opinion of the man on the street. He is neither a politician nor an industrial executive. But his hide and his pocketbook are at stake in the national defense program—and he knows it. He has a right to the low-down on what is going on. And if he is left in ignorance or deliberately deceived, for the sake of either political or business whoopee, the payoff will be mighty poisonous political medicine for the politicians and equally poisonous business medicine for the business men who may be responsible.

* * *

The plain stark fact, to be faced squarely by us all, is that the national defense program is an emergency project—a desperately urgent emergency project.

As in every emergency that confronts a democracy, we are harassed by a confusion of counsel. As always, some of the confusion arises from honest but conflicting judgments, some of it from ignorance or muddy thinking. But, unhappily, much of it reflects the deliberate purpose of self-seekers to fish in troubled waters—to capitalize the conjunction of a national emergency and a political campaign to boost their own interests. Already the charge that American business men are unpatriotic and interested only in profit has been put out as a smokescreen to cover up deficiencies for which business men are in no way responsible.

Now the man on the street finds it hard to see through this maze of excited contradiction. Not because he isn't smart—the average American can think straight enough *when he has the facts.* But in this case the facts are obscure and complicated—they have to do with matters that are strange to him. And to make it worse, at the height of his confusion, raucous voices constantly assail his ear with "simple" explanations of it all. But, as so often happens, most of these "simple" explanations make the matter a lot simpler than it really is.

* * *

Consider, for example, the cry that "industry refuses to get busy on national defense until its profits are guaranteed". Very clear and simple, to be sure; but also very false. The charge that American capital is "on strike" in the hour of national need. As silly as it is simple. The assertion that our manufacturers "won't even talk with a government anxious to place orders with them, without large financial concessions", and that "American corporate industry refuses to expand its resources for defense until it receives immunity from proper taxation". The resounding demand that we "conscript wealth as well as men"—whatever that may mean.

Particularly political has been the attack on the aircraft industry. It has been made to appear that aircraft manufacturers were instituting a sit-down strike because, in their greed for profits, they demanded more than 8%. Actually the 8% was not a net profit at all and the only concern of the manufacturers was to fight against incurring losses under the 8% limitation. And army and navy officers have sustained the aircraft manufacturers' viewpoint.

The air is full of explanations which, however simple they may sound, do not explain. And in most cases, I am convinced, the purpose of those who offer them is not to explain but to inflame. Those who try honestly to explain these issues from either side, find it impossible to do the job in such ringing phrases.

As I have said, our country has been caught short. As

a result, there are many reasons for the confusion and controversy. The plain fact is that we can produce our war equipment by only two means: (1) by converting the industries of peace into the industries of war, so far as that is possible; and (2) by building from scratch the new facilities we need to supplement them. In other words, we must create—with desperate haste—a new industry in America—an armament industry.

Right there is the crux of the problem that now confronts the industrialist sincerely trying to equip himself for his part in national defense. For this new armament industry is not the ordinary business risk against which he has learned to weigh the interests of his employees and his stockholders. It does not deal with familiar products and processes. It is not continuous—at least it has not been heretofore in this country—and it may fold up as suddenly as it has opened. It cannot hope to serve thousands of potential customers: it has but one sure customer—the United States Government—and wielding the sovereign power that customer can do just about as it pleases with respect to its needs and demands. Which means that not even this one is a *sure* customer.

* * *

No more unfair or deceptive charge ever has been leveled against American industry and American business men than the accusation of being unwilling to take the normal business risks of the defense program. The risks they are trying to minimize—they cannot possibly avoid them all—are very special and extraordinary risks indeed. So clearly is that true, that I doubt very much whether such questions and charges ever would have risen were it not for the fact we are engaged in a political campaign.

Already some of industry's great units have gone ahead with the building of new facilities, the purchase of special materials, and the actual production of armament in the face of all risks, gambling that their government eventually would work out some reasonable plan to protect them against excessive loss. Others, doubtless will follow suit.

But many other companies, for one reason or another, are not in position to do that. So before they begin to expand their facilities to handle defense contracts, they have asked their *only potential customer for those new facilities* to guarantee them—*not* excessive prices, *not* exorbitant profits, *not* immunity from taxation, as we are being told, but simply against the excessive losses that may result from very extraordinary conditions.

* * *

As this is written, it looks as though the legislation and the rulings necessary to accomplish this purpose soon will be forthcoming. Thoughtful and responsible officials of the government understand the situation and what is needed. But, unfortunately, their understanding and action will not quiet the professional business-baiters. So long as those gentlemen have their own interests to serve, so long as political excitement makes it easy to whip up public demand for a scapegoat to atone for disappointing progress with the defense program—just so long will the business-baiters find a receptive audience for their criticisms.

All of which suggests that business men must carry at this time a double responsibility, in addition to their obvious obligation to do the very best job they know how on their individual parts of the defense program.

The first of these added responsibilities is, of course, to avoid any possible basis for the charge that industry is exploiting the defense program in behalf of excessive profit, unfair treatment of labor or any other unworthy self-interest. The second is to see that the man in the street knows and understands all that I have tried to set down in the foregoing.

For the man in the street is deeply involved in all this. He is "in the street" only to the political orators. To the rest of us, he is the man in the factory, the man on the truck, and the man behind the orders that industry fills. In short, he makes up this living American industry on whom the politician's charges spatter. As an employee he has a stake in the solvency, the security, and the reputation of the very plants at which criticism may be directed. Knowing the facts, he can answer the critics so far as his own plant is concerned and can see how the same kinds of facts apply to all industry. If he is a customer, suffering inconvenience as a result of the plant's service to national defense, a knowledge of the facts behind the plant's problems will help to make him a defender rather than a critic of responsible business management. If he is a neighbor in the community, the facts will equip him to be an interpreter of industry's problems to the people of the home town.

* * *

In this national defense effort, business enters into a new partnership with government, but, more importantly, into a deeper partnership with the American people. It is more than ever essential that it take all of the American people into its confidence, beginning with the people in its plants and going out through the ranks of its customers and its community neighbors to show them that they have a common interest in seeing that the task of national defense is undertaken in the American way.

As we all know, there are in this country some people who would like nothing better than to see American industry fail in this supreme test of service to the nation. They will watch with jealous eyes every move of every company that is engaged on a defense job. They will disparage its achievements, exaggerate its shortcomings, and distort its motives. For they would like to make over American industry to their own pattern, and they'll never have a better chance to get started with it than has been opened up by the national emergency. Or so it looks to them.

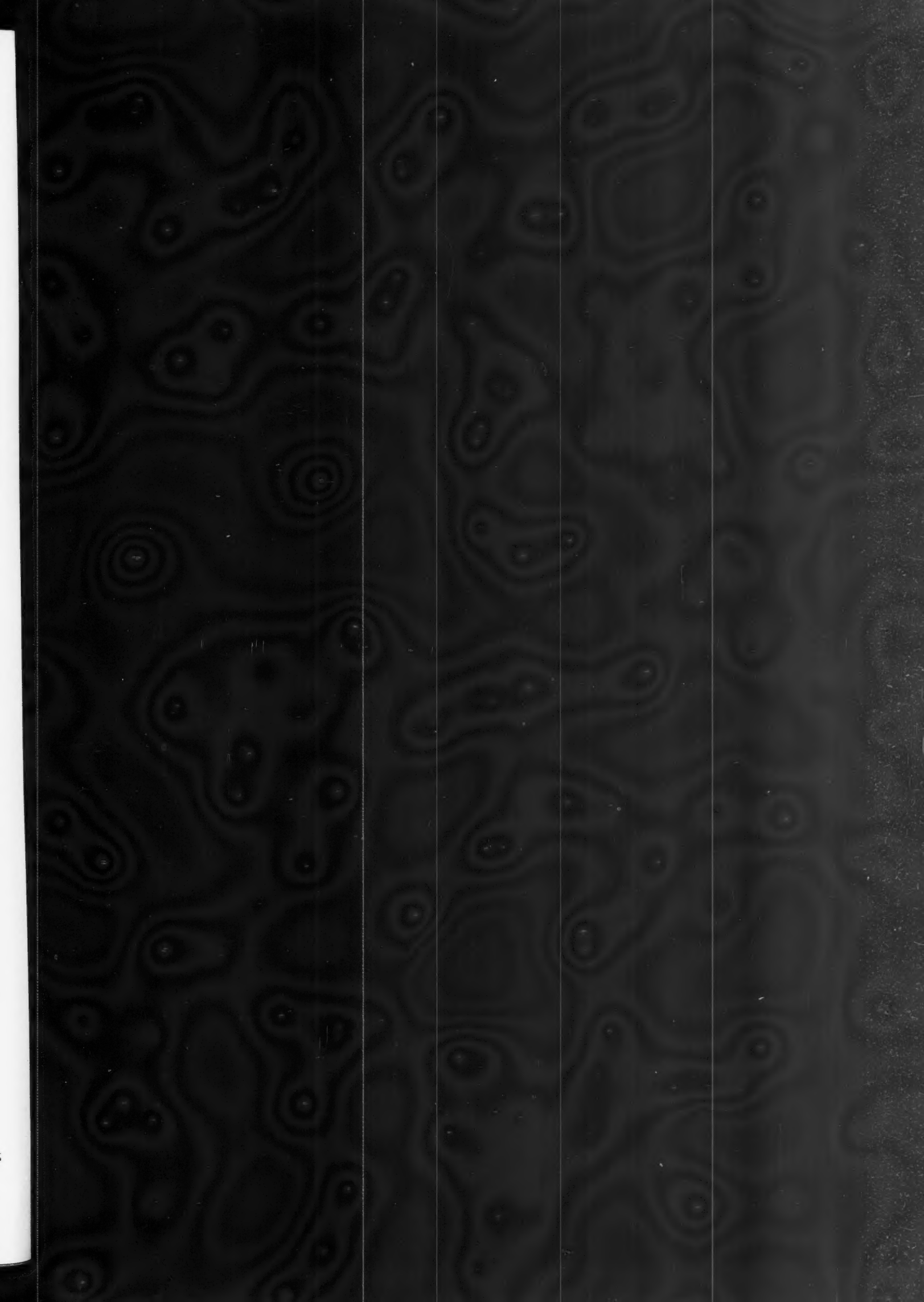
So, great as are the business hazards of the defense program for the individual business man, even greater hazards are involved for American industry as a whole. But, knowing the temper of American industrial leadership as I do, I am confident that it will handle its defense assignment with credit to itself and with great advantage to the nation that it serves—whether in war or in peace.

To help in that supreme test is the opportunity and the privilege of the McGraw-Hill organization.

James H. McGraw Jr.

*President, McGraw-Hill Publishing Company, Inc.*

***This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.***



POWER

Established 1882 • PHILIP W SWAIN, Editor

# Lester Paige Breckenridge

By FRED R LOW

*Reprinted from POWER, June 12, 1923**

With the completion of the present term, Lester Paige Breckenridge retires as head of the Department of Mechanical Engineering of the Sheffield Scientific School at Yale University.

For forty years he has been a teacher of mechanical engineering. "What a delightful experience!" he says, in relinquishing it.

Forty years of imbuing young men not only with the principles of mechanical engineering, but with the mental habits of the engineer.

Forty years of watching his boys, as he calls them, go out and win the places in the world for which his teaching has prepared them.

I never sat with him in a club or hotel or wheresoever men assemble, no matter how far from home, that he was not hailed a number of times through the meal or chat, by somebody passing through or who left his own table to come up and speak.

"One of my boys," would be the proud explanation as the caller walked away.

"A delightful experience," he may well say. A wonderful experience to have had a part in the remarkable development of engineering during the past twoscore years; to have been the "Breck" of thousands of its practitioners; to have served not only his school but his city and state, his profession and country, in many important associations and appointments.

We cannot imagine Professor Breckenridge as idle. He may retire to the green hills of Vermont in the summer, but he has "built him a house by the side of the road" up there and will continue to be an interested friend of man. He may go in the winter where, as he says, he "will not have to shovel snow or coal," but he is too dynamic not to continue to radiate suggestion and inspiration and to have an inductive interest in what is going on.

I have known him long, and that is a privilege. I have worked with him, and it has always been a pleasure. I congratulate him upon the completion of his twoscore years as an educator and wish for him a long term of physical fitness for the enjoyment of the leisure that he has so richly earned.

* Lester Paige Breckenridge, died August 22, 1940, at the age of 82. A brief account of his life appears on page 130. As one of the devoted company of "Breck's Boys", I present above the tribute of POWER's pioneer editor, Fred Low, to his dear friend. Fulfilling the wish expressed in Low's last paragraph, "Breck" spent the remaining seventeen years of his life in honored and happy retirement at his farm in Vermont. His was a great and radiant spirit. Many a pilgrim has paused at the "house by the side of the road" for never-failing inspiration and guidance.—PWS

# Model Tests Solve High-Pressure Pipe

***Accurate scale models of high-pressure, high-temperature steam lines give measurable end reactions and moments that would involve long calculations otherwise. Joseph D Conrad, Steam Turbine Division of Westinghouse Electric & Mfg Co, tells how effect of pipe expansion on turbine parts is checked***

▶ STEAM AND MANY OTHER internal-pressure pipelines are subject to a rise in temperature during a normal cycle of operation. If the ends of these pipes were not restrained, they would expand due to the temperature rise. The restraint actually imposed on the end of the pipe resists this expansion and sets up reactions and moments and creates a state of stress in the pipe walls.

Methods of calculating these end reactions, moments and stresses have been extensively published. As long as the pipeline lies in one plane and is supported at the ends only, the calculation can be performed readily. A 3-dimensional pipeline supported only at the ends can also be calculated, although the work is more involved than that in the single-plane pipe. As soon as one starts to add branch lines, partial intermediate restraints, spring hangers, etc, the calculation work becomes more and more difficult, and on the more intricate systems, practically hopeless.

### *Measure Forces*

A method for determining these expansion forces and moments in piping by the use of model testing was described by H W Semar in the transactions of ASME (Journal of Applied Mechanics) for March, 1939. This method consists of testing a scale model of the pipeline. One end of the pipe model is clamped in a stationary force-measuring head and the other end in a sliding head. The sliding head is set to move only in the direction the pipe end would move with unrestrained expansion and it prevents any rotation of the pipe model at this point. The force-measuring head prevents translation or rotation at the other end of the model. Six pure forces, measured with a calibrated-spring arrangement, are sufficient to fix this pipe end completely. Details of this force-measuring apparatus and all necessary formulas for converting results are contained in the above-mentioned article.

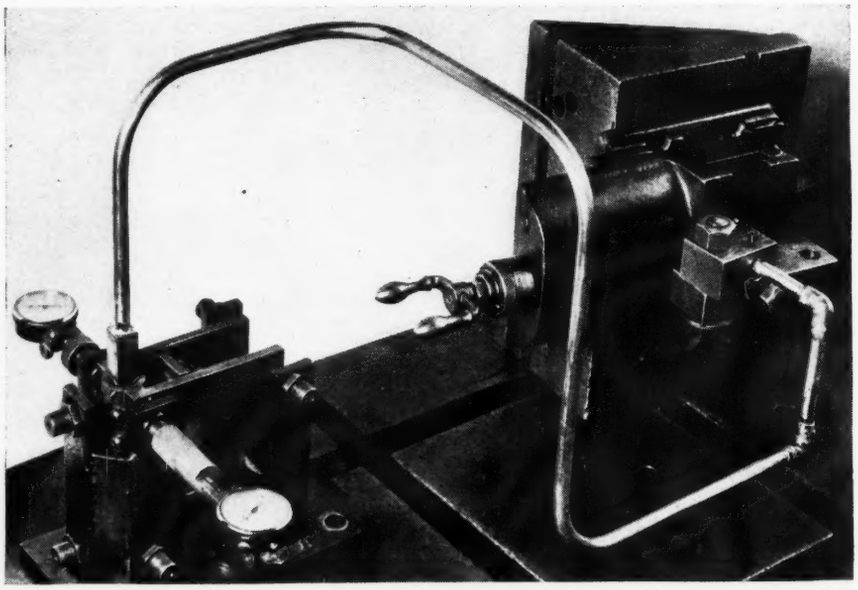


**Fig. 1—Simple 3-dimensional pipe system set up for test. Pipe model is compressed cold same proportionate amount as it would expand when heated**

This method has been used for the analysis of pipe systems by the Westinghouse Co for the past several years. Models of more than 20 different lines have been built and checked. Even on the less complicated 3-dimensional system, it has been found more satisfactory than calculations. A typical example of such a system is shown in Fig. 1. The time to make this model and run the test is probably about as great as performing the calculations. However, possibility of error is far less in model testing than in any method of calculation, and is preferred for that reason.

The first special problem attempted with model testing was a 3-dimensional system with a branch line. With the calculation method, the work immediately becomes involved. A calculation can be made by first neglecting the branch and then making some approximations in regard to additional forces and rigidity caused by this branch. Such calculations might easily be in considerable error. More rigorous methods become extremely complicated and laborious. With model testing we simply make the model, including the branch, and use an additional sliding head for the branch and another for the branch anchor.

One of the main pipe anchors can be selected for a reference point and the force-measuring device placed there. The unrestrained motion at the other main anchor and the branch anchor are calculated for temperature rise both in regard to magnitude and direction. The sliding heads are placed at these anchors and are set to give the proper direction of motion and then are moved the calculated amounts and the forces and moments are measured at the reference point. Fig. 2 illustrates such an arrangement.

This is a simplified setup and gives only the forces and moments on one anchor point. This is all that is usually required by the turbine builder; however, a complete stress analysis may be made by repeating the test with the force-measuring head placed at one of the other anchor points. A still better system for getting data sufficient for stress analysis may be obtained by mounting a second measuring head on one of the sliding heads and measuring simultaneously all forces and moments at the two points.

# Problems

An extremely complicated problem is illustrated by the system shown in Fig. 3. Here we have a pair of 3-dimensional lines tied together by a cross-over connection. The problem is to determine reactions at all four anchors and to make a complete stress analysis of the pipe system under five conditions of heating: (1) all piping hot; (2) right side hot, left side cold; (3) opposite of (2); (4) right side hot to crossover, cold remainder of way, left side cold to crossover, hot remainder of way; (5) opposite of (4).

### *Using the Models*

To make such an analysis by calculation only is obviously out of the question. With model testing, however, it is a straightforward job. In this case, all four anchors were mounted in moving heads and a force-measuring assembly attached to each head. The direction and amount of expansion at each head was calculated with reference to the center of the crossover. This allowed minimum change in the setup in going from one heating condition to another.

Four force-measuring heads gave simultaneous readings at all anchors. This also provided an excellent check as any three sets of readings were sufficient to make the remainder of the forces and moments statically determinate. Of course, to make a stress analysis of such a system, there is still a large amount of computation necessary after we have obtained anchor reactions and moments from the model-test readings. However, as those familiar with piping calculations will recognize, when these anchor results are known the main hurdle for a complete analysis has been cleared.

Occasionally, designers resort to corrugated sections to increase flexibility of a pipeline. A corrugated piece of straight pipe has about five times the bending flexibility of a plain pipe, while its flexibility in torsion is about the same as plain pipe. To make a scale model of a piece of corrugated pipe would be a rather costly job. All that is necessary in the model, however, is to accomplish the proper ratio of torsional to bending flexibility in the corrugated portion. This has been done by the use of a specially slotted piece of plain tubing. By changing the width and depth of the slot, the relation between torsional and bending flexibility can be varied.

This is a trial and error procedure but we were fortunate enough to get the proper relation on the first attempt. The relative flexibility is quite easily measured by loading a slotted cantilever tube through a crank arm and measuring linear and angular deflection simultaneously at the end of the tube. When the proper ratio of flexibility has been obtained in the slotted tube, the size and wall thickness of the tubing in the remainder of the model can be chosen to give the proper flexibility relation between the corrugated portion and the plain portion. Fig. 4 is a model using corrugater section simulated in the above described manner.

### *Turbine-Exhaust Line*

In a large-diameter pipe, such as the exhaust line on a superposed turbine, the chief problem of the designer usually is to control the end reaction and moments rather than the pipe stresses. Guides of various types, struts, stops, rollers and other devices are introduced to reduce these and reactions and moments. Too often one only guesses or hopes for benefits from such devices. Means of calculating the effect of such are difficult or impossible. The model test furnishes an excellent means of actually measuring the results. Fig. 4 also illustrates such a model test for a turbine-exhaust line. The model is rotated 90 degrees from the actual pipeline for ease of testing.

The line as shown was quite satisfactory except for a large bending moment in the vertical plane. There is a branch line to the atmospheric-relief valve of which only one leg is shown in the

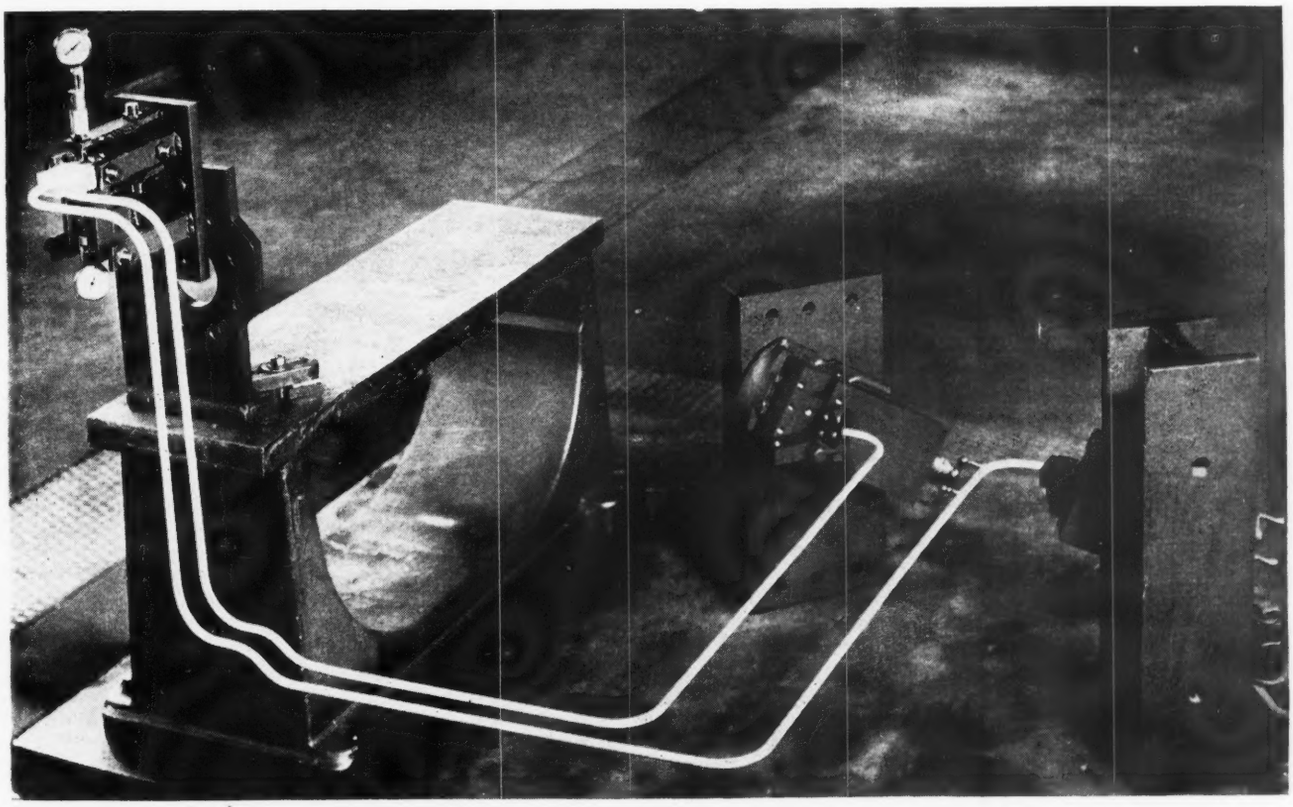


**Fig. 2—Model set-up of 3-dimensional pipe system having a long branch line which also contributes to end reactions**

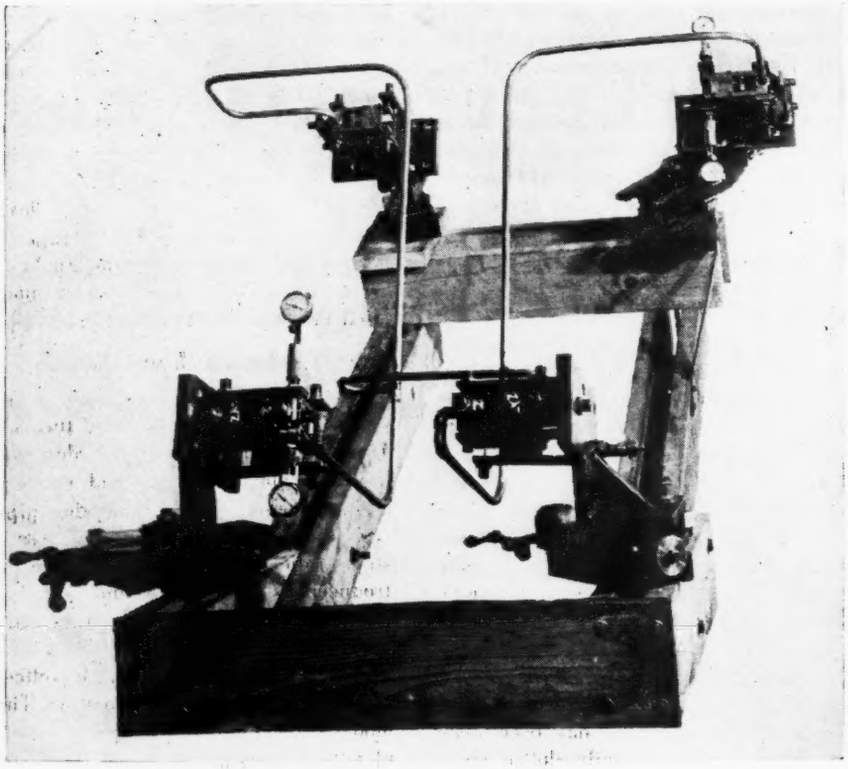


**Fig. 3—Example of highly complicated, double, 3-dimensional pipe system with crossover connection, in which use of models proved satisfactory**

model. It was proposed to attach tie rods in this atmospheric-relief line in a manner believed to reduce considerably the large bending moment on the turbine-exhaust flange caused by the expansion of the main exhaust line. These tie rods were to be installed to prevent movement in two directions and rotation in one plane. Otherwise, the pipe was free to move at the point of its attachment.

### *Cold Stressing*

The method of simulation of this restraint is easily seen from the photograph. Each of the main anchors is mounted on slides and expansion is computed with reference to the point of attachment of the tie rods in order to get the true effect in a model working without actual heating. The first attempt at locating these tie rods in a horizontal run of the atmospheric branch (not shown) proved quite ineffective. The location in the vertical lag of the line as shown was most effective in reducing bending moment on the turbine. Here the model testing was almost indispensable in assisting the designer to determine the proper location and actually obtaining the true effect of such tie rods.

Still another innovation employed in model testing has been the determination of two effects separately and then getting the combined results by superposition. The effect of a spring support in a line is readily determined in this manner. Such a problem is encountered in a line with any large weight between the anchor point, such as the throttle valve in the main steam line between the boilers, and the turbine. To anchor this throttle valve completely would simplify the calculation but would increase the difficulty of designing the pipeline both between the valve and the turbine and from the boilers to the valve.

Round end struts are provided to support the weight without resisting horizontal movement. A scaleless-type support or very low scale springs may be used under these struts to provide freedom of movement in the vertical direction. However, the weight to be supported is often 15,000 to 25,000 pounds and such supports become expensive where not entirely impractical. Methods of determining the effect of a spring support of more practical proportions can be accomplished by this double method of testing.

### *Two Separate Tests*

First the usual test is made without restraint at the position of the throttle valve. In this test, measurements are made at the throttle, from which point the unrestrained vertical movement can be computed. Measurements are also made of the usual forces and moments at the main anchor point. On the second test, a pure vertical force only is applied at the throttle valve from which position vertical movement can be measured. Also, the resultant reactions and moments at the main anchor are measured for this force as applied at the throttle valve position. These two tests give sufficient data for calculating all end reactions and moments in a straightforward manner.

The vertical force-movement relation at the throttle valve gives the scale of the pipe system for a force applied at this point. Let us designate this scale by the symbol $S_p$. Let $S_s$ equal the scale of the supporting springs. Let $X$ equal the free vertical movement at the throttle computed from the first test. Let $F$ equal the actual restraining force caused by the spring support under the throttle valve. We can then write the relation $F = X\ (S_p - S_s)$. With the data on the end reactions and moments obtained from the second test and this value of the restraining force ($F$) at the throttle valve, we can easily compute the anchor reactions and moments

## Exhaust Lines

By L N ROWLEY

A new surface indicator produced by GE engineers will register differences in thickness of as little as *one-millionth* of an inch. The device resembles a phonograph—the turntable carries the object to be tested while a sapphire-pointed needle rides over the minute surface irregularities. An electromagnetic pickup converts these weak mechanical impulses into electrical impulses which are amplified to make a magnified record of the surface "contours".

*Rumors from Canada mention a 300-mph storage-battery-powered airplane, with a cruising range of 3 hours. Development of a battery light enough to be used efficiently in a plane would have widespread industrial significance.*

No need to wonder why they call locomotives "she", *U. S. Steel News* makes it easy. "She" wears a jacket with yoke, pins, hangers, straps, and stays. "She" has an apron, also a lap; and not only pumps and hose but even shoes. "She" surmounts great obstacles but sometimes jumps the track at the slightest provocation.

as caused by this restraining force only. From the first test we have the end reactions and moments due to the expansion in the system without restraint at the throttle valve. The final results are obtained by adding these two sets of end reactions and moments.

Above is a description of details for determining the effect of a single intermediate restraint. The effect of additional restraints may be determined in a similar manner. Fig. 5 shows a model of a steam-turbine inlet line which has been inverted for ease of testing. Here the effect of two restraints was determined. The pure forces were applied by the use of weights over pulleys. In the actual line, the throttle valve is supported by springs and, in addition, a single horizontal tie rod is attached to the line near the throttle valve to reduce the major component reaction on the turbine connections. The effect of each of these restraints was determined by separate tests and the final results obtained by superposition.

It is possible to obtain the result of a number of restraints or supports by actually simulating some and making separate tests for others. The effect of as many as five intermediate restraints and supports has been determined by this method.

Another feature of model testing is the ease with which one is able to determine the movement of the pipeline at any point. This information is very desirable in designing and locating pipe hangers. The movement due to deformation may be read directly from the model with dial indicators. The free-expansion movement is readily computed and the actual movement is obtained by taking the algebraic sum of these two quantities. Only a few extra hours are necessary to obtain such information from a model of even a complicated pipeline. Determination of such movements by calculation becomes a major task if more than a very rough approximation is contemplated.

This kind of model testing is now regarded by the Westinghouse Co as the most practical method for solving 3-dimensional pipeline stress problems. For systems with branch lines, intermediate restraints, etc, it is regarded as almost indispensable where a complete analysis is necessary.

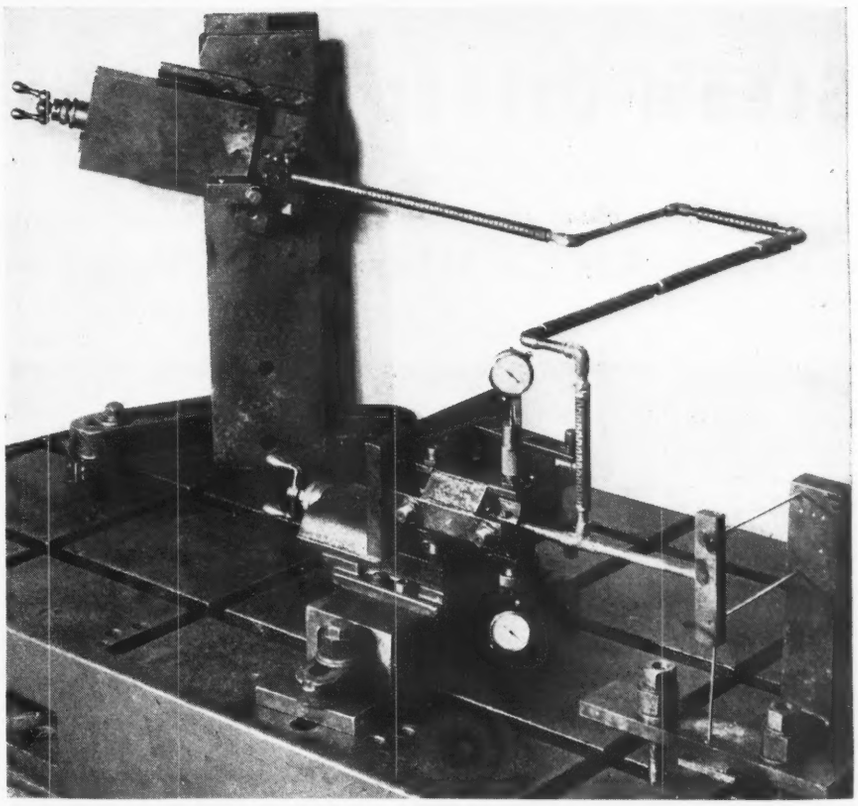
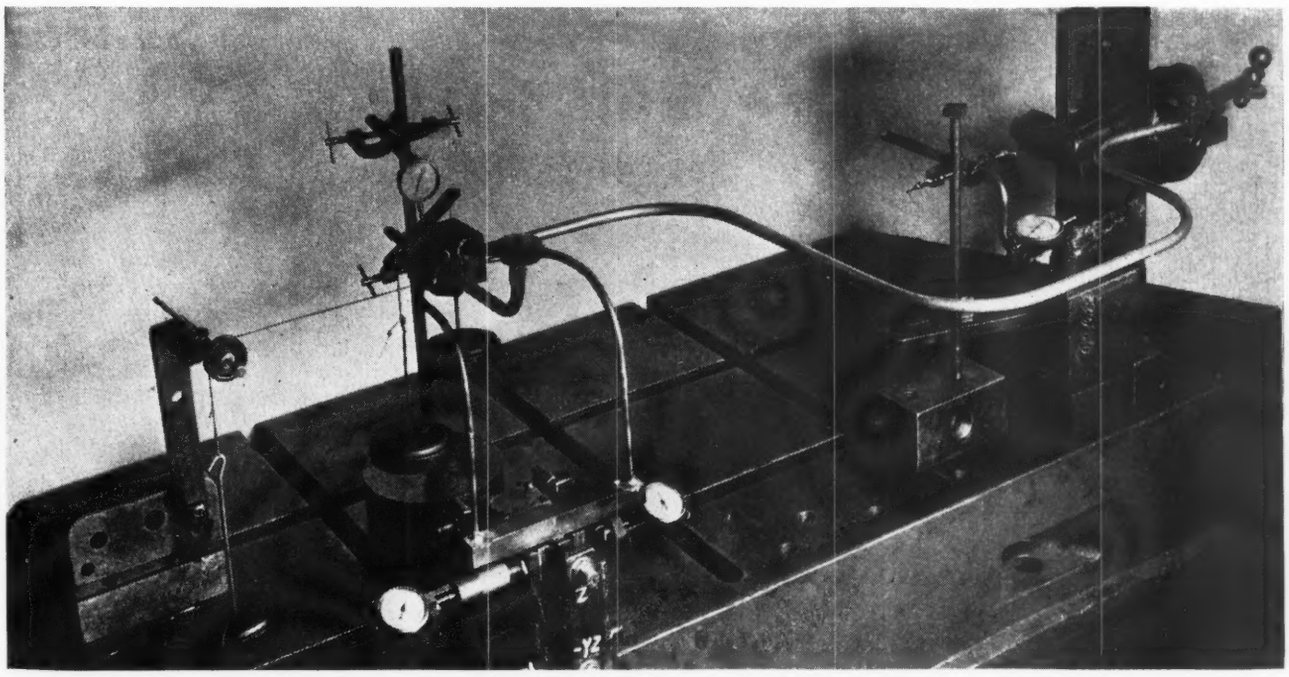


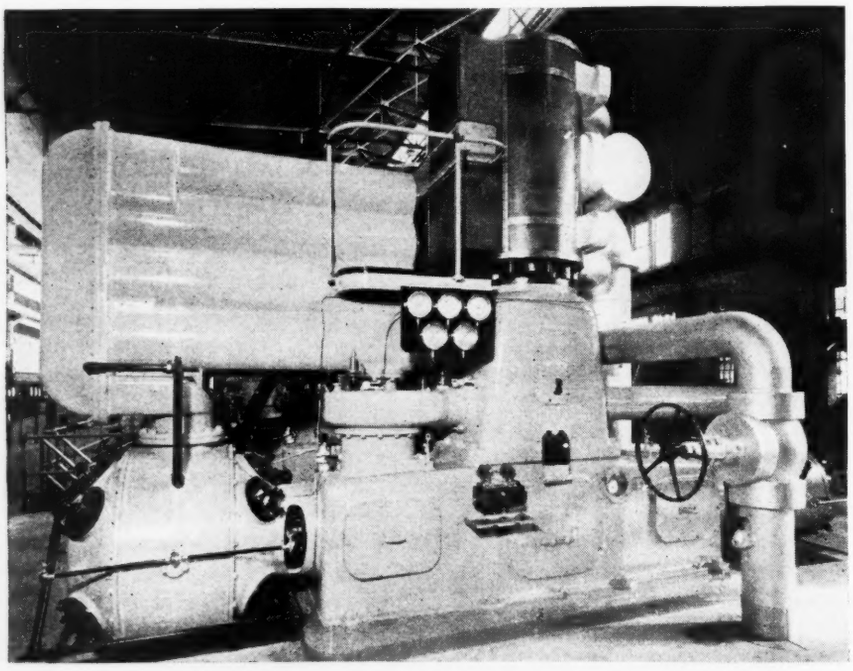
*Fig. 4—Slotted tubes simulate corrugated piping of actual pipelines*

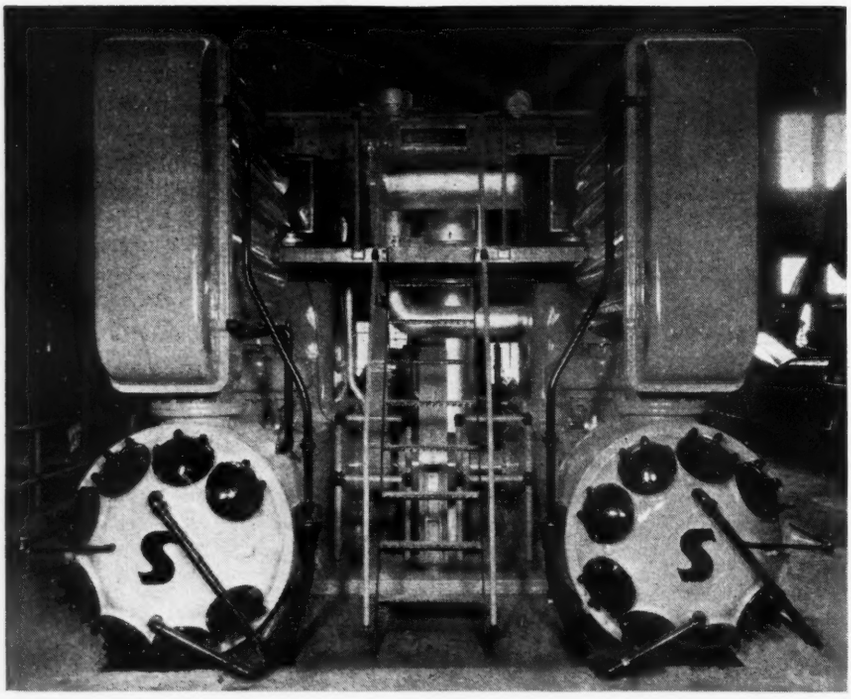
**Fig. 5—Model for determining the effect of two restraints**



# Steam-Driven Air Compressor Takes

***Garfield, Utah, plant installs 4500-cfm compressor of novel design. Unit described and results reported by P K Richardson, power engineer, American Smelting & Refining Co***





**Two views of the steam-engine-driven, 4500-cfm air compressor. Upper photo shows low-pressure air cylinders at left, steam-engine cylinders at center, and high-pressure cylinders at right. Other photo is of low-pressure end. Each side of this machine is a complete 2-stage compressor in itself, joined by a 9.5-in. diameter divided crankshaft clamped together by a split-hub, solid-rim flywheel weighing 8000 lb**

► COMPRESSED AIR for general plant use at the American Smelting & Refining Co, Garfield, Utah, was formerly supplied by a horizontal, cross-compound steam-driven unit, with corliss steam valves and plate air valves. This machine had been in constant operation for some 20 years, and finally reached the point where replacement was necessary.

Floor space available for installation of the new unit was limited to the area occupied by an 18,000-cu-ft blowing engine. It was necessary to place both a large centrifugal blower and the new air compressor in this space, so it was not possible to consider the usual horizontal steam-driven compressor. An electrically driven machine would have fit the space, but not enough generator capacity was available to drive it.

### *New Design*

The compressor finally installed was a new design which incorporated many years of experience on the part of the Sullivan Machinery Co, the manufacturer, but which had not heretofore been built and operated.

Specifications called for a steam-engine-driven machine to have a capacity of approximately 4500 cfm of free air compressed to 100 lb pressure. Throttle steam conditions were 150 lb g, 100 F superheat and exhausting to 26 in. vacuum referred to 30 in. barometer. As the plant is 4300 ft above sea level, our normal atmospheric pressure is 12.6 lb.

### *Duplex Machine*

The compressor unit, designed for many years of continuous service, has two heavy main frames arranged with horizontal air cylinders and vertical uniflow steam cylinders (supplied by Skinner Engine Co), comprising a T-shaped pattern. Each side is a complete 2-stage compressor in itself, but the machine was designed as a duplex unit, joined by a 9.5 in. diameter divided shaft. This is clamped together by a split-hub, solid-rim flywheel weighing 8000 lb.

The main crankshaft bearings con-

# Small Space, Has High Efficiency

sist of two SKF double-race roller bearings, 10.235 in. inside diameter and 19.29 in. outside diameter.

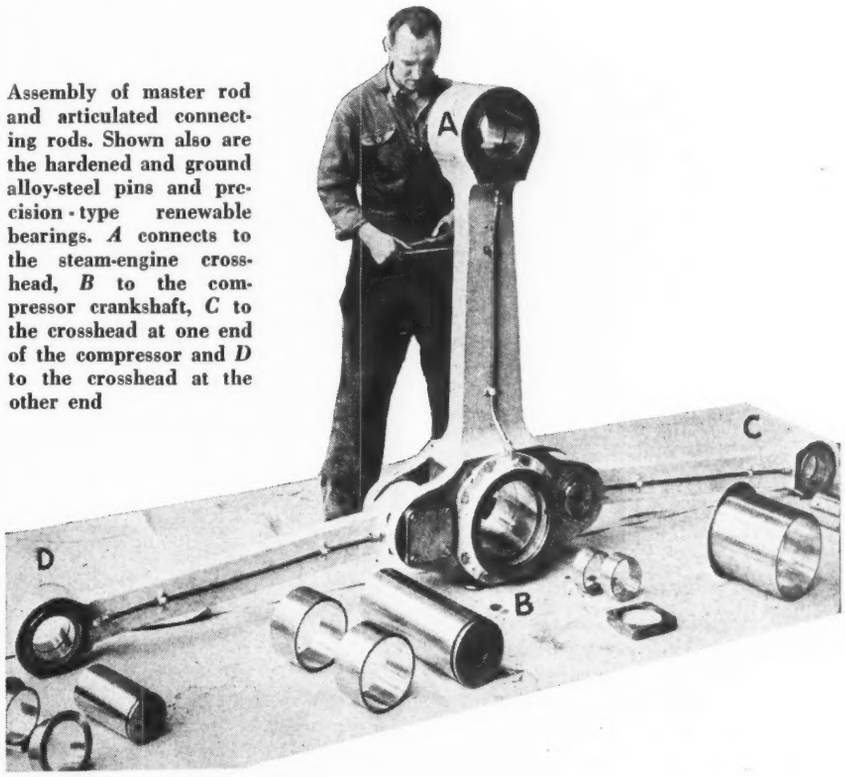
The vertical connecting rod which delivers power to the compressor cylinders serves as a master rod; the connecting rods from the two air cylinders on each side are connected to this master rod. All crank-pin, connecting-rod and crosshead-pin bearings are non-adjustable.

Connecting rods are all solid end and have babbit-lined, steel-bearing bushings pressed into the rods. Crossheads are solid and also non-adjustable. Any necessary change in alignment can be made by shimming the crosshead guides. All bearing surfaces are lubricated by pressure from chain-driven, gear-type oil pumps on each side of the machine and driven off the ends of the crank pins.

### *Air Cylinders*

The high- and low-pressure air cylinders, of 17 in. and 28 in. bore respectively by 20 in. stroke, have replaceable cylinder liners, and circular concentric plate, spring-backed valves, set in the cylinder heads with their axes at an angle of approximately 45 deg to the horizontal center line of the machine.

Steam cylinders, 25 in. bore by 20 in. stroke, are full uniflow. Cylinders, pistons and heads are alloy semi-steel. Steam-inlet valves are double-beat-expansion-compensating, made of forged steel, with forged alloy-steel beams. Steam valves are actuated by bell cranks equipped with needle bearings operated by a cam shaft, chain-driven from the crankshaft. Each cylinder has hand-operated clearance pockets to permit emergency operation with atmospheric exhaust.




**Assembly of master rod and articulated connecting rods. Shown also are the hardened and ground alloy-steel pins and precision-type renewable bearings. *A* connects to the steam-engine crosshead, *B* to the compressor crankshaft, *C* to the crosshead at one end of the compressor and *D* to the crosshead at the other end**

After the machine was erected and run long enough to break in all bearing surfaces, it was subjected to a rigid acceptance test, which is a policy of the smelting company whenever important power-house units are purchased. The test (see table) was conducted by the Engineering Dept of the American Smelting & Refining Co in the presence of representatives of the manufacturers, in accordance with test codes of the ASME and the Compressed Air Society.

### *Operation OK's Machine*

The acceptance test indicated that the machine met all the manufacturers' guarantees of capacity and economy. Since being accepted by the purchaser, this machine has been in constant operation for over a year, and has given every indication of future long and useful service.

## Test Results of Steam-Engine-Driven Air Compressor

### *at Garfield, Utah, Plant of American Smelting & Refining Co*

| | |
|---|---|
| Actual free air delivered, cfm | 4551 |
| Piston displacement, cfm | 5108 |
| Volumetric efficiency, % | 89.08 |
| Indicated hp (steam cylinder) | 779.36 |
| Indicated hp per 100 cfm (steam cylinder) | 17.13 |
| Steam consumption, lb per indicated hphr | 12.73 |
| Steam consumption, lb per 100 cfm | 3.635 |
| Over-all efficiency (isothermal) | 70.34 |
| Steam conditions throttle, lb per sq in. g | 150.92 |
| Steam conditions superheat deg F | 106.50 |
| Steam conditions exhaust, in Hg abs | 4.22 |
| Average intake barometer, lb per sq in | 12.60 |
| Air discharge pressure, lb per sq in. g | 101.58 |
| Speed, rpm | 179.43 |
| Steam-cylinder bore, in | 25 |
| Steam-cylinder stroke, in | 20 |
| Low-pressure air-cylinder bore, in | 28 |
| High-pressure air-cylinder bore, in | 17 |
| Air-cylinder stroke, in | 20 |
| Weight of machine, lb | 185,000 |

# Power-Factor Correction With

***Harland O Poland, Westinghouse Electric & Mfg Co, shows how to determine the maximum output of synchronous motors driving mechanical loads and supplying leading reactive kva for power-factor correction***

▶ OPERATING ENGINEERS know that synchronous motors can correct lagging power factor of induction motors and other inductive equipment on a power system. They frequently do not know, however, how to determine the amount of mechanical load a given motor can drive when supplying reactive kva for power-factor correction.

Synchronous motors are designed for two standard full-load power factors: unity and 80% leading. Unity-power-factor motors, when operating under their rated conditions, supply no wattless kva to the system. The 80% power-factor motor, when driving rated mechanical load and with rated current in its windings, supplies 60% wattless kva to the system.

### *Thermal Limit*

The ability of synchronous motors to supply power-factor corrective effect is limited by the thermal capacity of both stator and field windings. Any stator winding is suitable for a definite kva load. No matter whether this load is mostly mechanical energy in the form of shaft kilowatts or whether it is mostly power-factor corrective effect in the form of leading kva, the heating effect is essentially the same.

Heating the field windings of a given motor also depends upon the current that the winding carries. Any change in the division of total kva load between mechanical and leading reactive kva will entail a change in the field current. Safe limits of this current must be kept in mind when examining a motor for maximum operation.

The power-factor corrective effect that can be obtained from a unity-power-factor synchronous motor is relatively small when it is delivering rated mechanical load. This is because the stator winding is designed for a total current equal to that required to drive full rated mechanical load, and the field winding is designed for an exciting current necessary for unity-power-factor operation only. Any change in the way the kva load of the motor is divided requires a change in field current, and there is very little chance for increasing this current in a unity-power-factor motor of normal design.

In general, a unity-power-factor synchronous motor is less expensive than an 80%-power-factor motor of the same horsepower rating because of the smaller amount of material required in manufacture. Also, the former is more efficient and its pull-out torque, because of limited field capacity, is considerably lower than that for an 80% machine. It should be pointed out that, although the corrective ability of a motor rated 100% power factor is relatively low, adding to the system any apparatus operating at unity-power-factory will improve the system power factor to some extent.

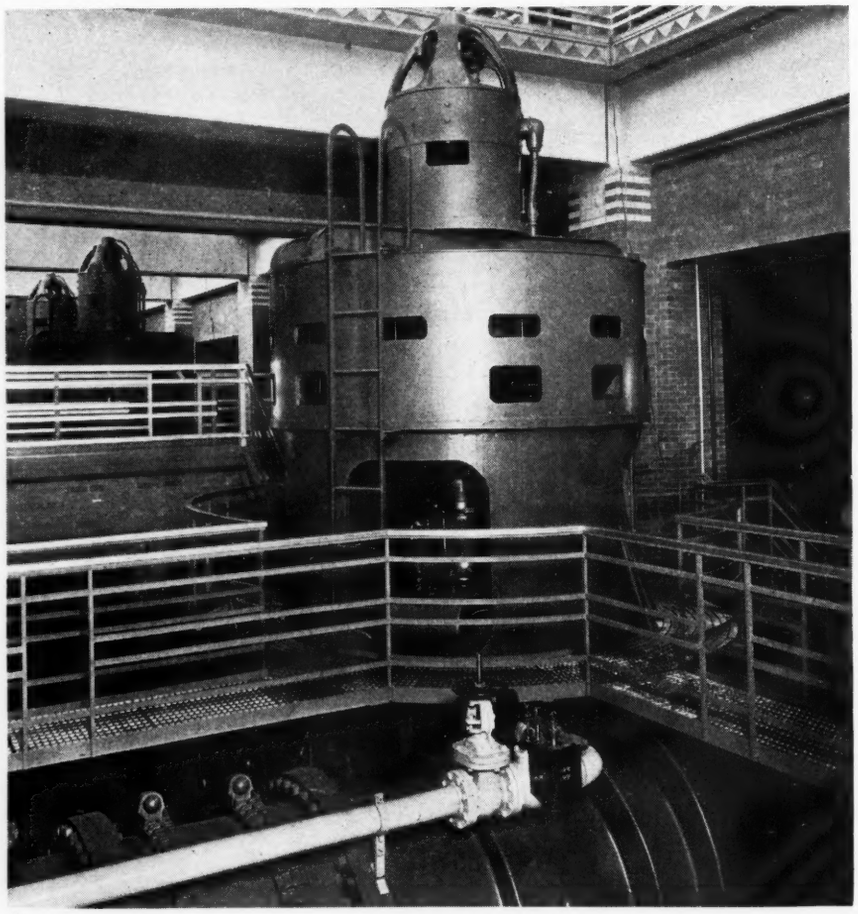


**Fig. 1—Vertical, 550-hp, unity-power-factor, 180-rpm synchronous motors drive pumps in a sewage-treatment plant**

Where appreciable power-factor correction effect is desired in addition to mechanical power, a synchronous motor rated 80% power factor is generally used. Such a motor is somewhat more expensive than one designed for unity power factor and is slightly less efficient due to the leading wattless current its windings must carry. Because of greater field current it has a pull-out torque considerable higher than a comparable unity-power-factor motor.

The groups of curves, Figs. 2 to 7, will determine the corrective capabilities of modern synchronous motors. These curves are representative of the synchronous motors used today and in the majority of cases they will give

# Synchronous

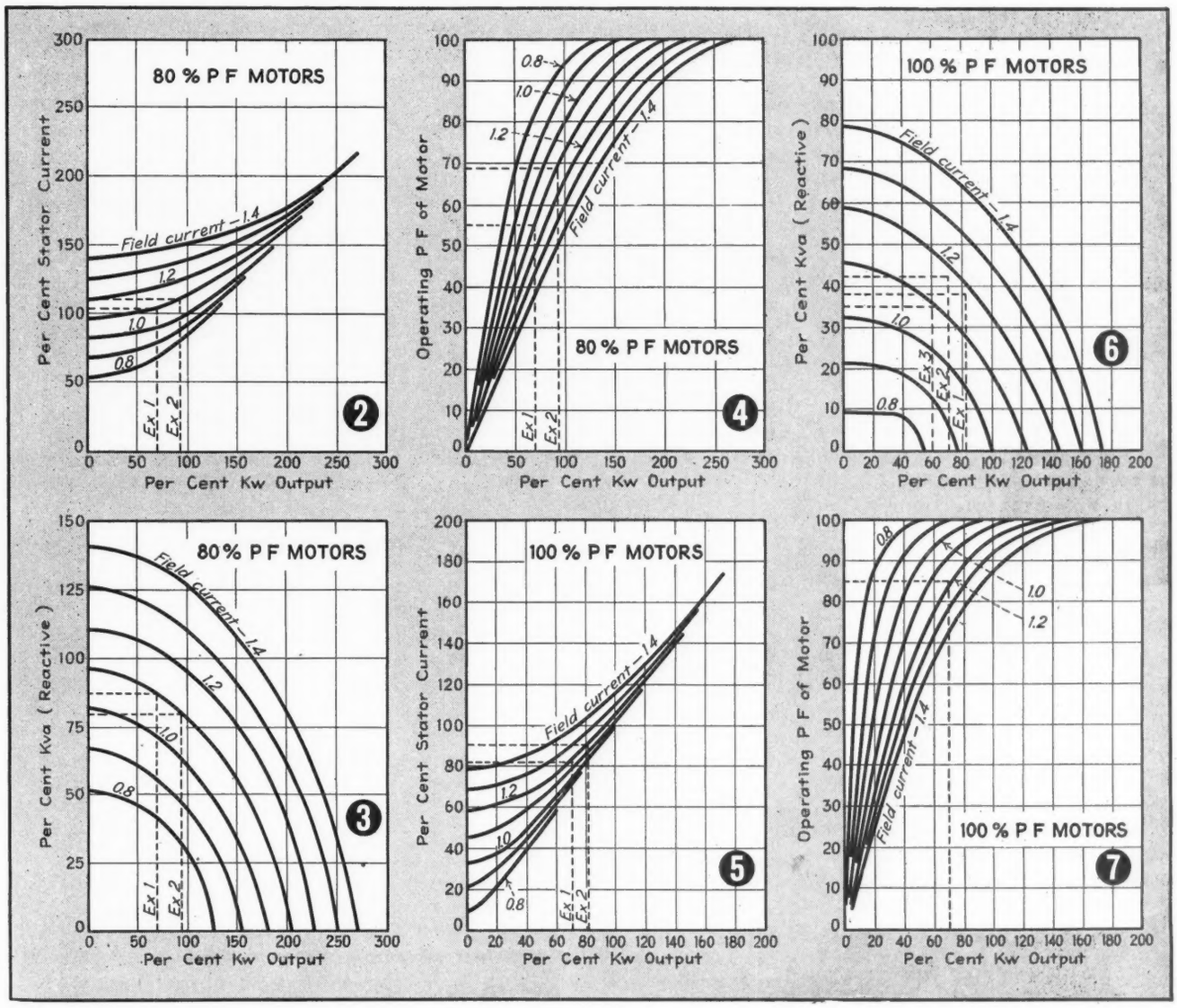
results accurate enough for any practical estimate. The values of leading reactive kva, stator amperes and kilowatt output are given in per cent of the normal nameplate rating of the motor. Field current is given in number of times nameplate value. Use of the curves is shown by the following practical examples:

A synchronous motor is rated 200 hp, 149.4 kw output, 201 kva, 50.5 amp input, 0.80 pf, 2300 volts, 900 rpm, 3 phase, 60 cycles, 125 exciting volts, 22 exciting amp. The motor manufacturer states that the maximum allowable stator current can be 115% full-load value (58 amp) and the maximum allowable field current is 110%. Is this satisfactory?

Solution: Fig. 2 shows that 110% field current gives a stator current of 104%, or 52.5 amp. This is less than the allowable 115% stator current, but since the field current is at 110%, its maximum allowable value, the field-coil temperature is the limiting factor in this case.

[illegible] intersect the 110% field-current curve. Then drop vertically and find that the kilowatt output can be 94%, or the maximum horsepower load can be 200x 0.94=188 hp. Checking on the curves, Fig. 2, we find that 94% kw and 110% field current give a stator current of

**Figs. 2 to 7—Curves for checking percent load and field current taken by synchronous motors**



about 110%, which is a safe value.

Assume we want to find the field current to supply 150 reactive kva (75%) and a 40-hp (20%) mechanical load. On the curves, Fig. 3, 20% kw output and 75% reactive kva give a field current of about 96% nameplate rating, or 22x0.96=21.1 amp.

### *Unity-PF Motors*

By using Figs. 5 to 7, this procedure may be applied to unity-power-factor motors. For example, take a motor that has the following nameplate data: 200-hp, 149.4-kw output, 1.00 pf, 157 kva, 39.4 amp input, 2300-volts, 900 rpm, 3 phase, 60 cycles, 125 exciter volts and 19 exciter amp. The motor manufacturer states that maximum allowable stator current can be 115% of normal full-load value or 39.4x1.15= 45.4 amp. Also, that the maximum allowable field current can be 118% of normal full-load value and unity-power-factor, or 19x1.18=22.4 amp.

We wish to find the maximum reactive kva the motor can supply for power-factor correction when driving a 140-hp mechanical load with 118% or 22.4 field amperes. 140-hp load equals (100x140) ÷ 200 = 70% rated motor output or 70% of the kilowatt output. It will be seen from Fig. 5 that, with 70% kw output and 118% field current, the maximum values of stator current can be only about 83% full-load value compared to 104% for the 80%-pf motor. This is true, in spite of the fact that the unity-power-factor motor is taking a greater percent field current than the 80%-pf motor. In both cases, the field current, and consequently field temperature, limits the motor output, but this limit is much lower on the 1.00-pf motor than on the 80% design.

Referring to Fig. 6, we find that, at 118% field current and 70% kilowatt output, the maximum reactive kva for power-factor correction is about 42% of full-load value, or 157x0.42=66kva, compared to 175 kva for the 80%-pf motor. The power factor at which the motor will operate will be 0.85% leading and can be obtained from Fig. 7.

To find the maximum mechanical power output from the motor when it is supplying a given reactive kva, assume a reactive kva load of 60. This is equivalent to (60x100) ÷ 157 = 38.1% reactive kva load. In Fig. 6, by using 118% field current and 38.1% reactive-kva load, we obtain 81% kw output, or 200x0.81=162 hp. Checking the stator current on Fig. 5, we find that this is about 91%, well within the 115% limit set by the motor manufacturer.

Even though the unity-power-factor motor supplies 60-kva reactive load compared to 160 for the 80%-pf motor, the latter can drive 26 hp more mechanical load than the former. The marked difference in the two motors for power-factor correction is clearly evident in Figs. 3 and 6. With field current limited to 110%, the 80%-pf motor can supply 95% of rated capacity as reactive kva for power-factor correction at zero mechanical load, but the unity-power-factor motor can supply only 56% with 118% field current.

Another typical problem is set up by these conditions: We have to drive a given mechanical load and require a definite amount of reactive kva for power-factor correction; we want to check the field current to see if the motor can meet the requirements. Assume a mechanical load of 120 hp (60% of motor rated output) and 55 reactive kva (35% of motor rated kva) for power-factor correction. On Fig. 6 a horizontal projection of 35% kva and a vertical projection of 60% kilowatt output met at a point indicating 109% field current, or 19x1.09=20.7 amp. The field current is within the maximum allowable value of 118%.

When using the curves to obtain an approximate operating point, make a check on the curves, Figs. 2 or 5, to make sure that the desired operation does not exceed the limits of field or stator current.

Sometimes the problem arises of how to get the maximum mechanical output with maximum possible power-factor correction in the power system. Con-

*(Continued on page 134)*

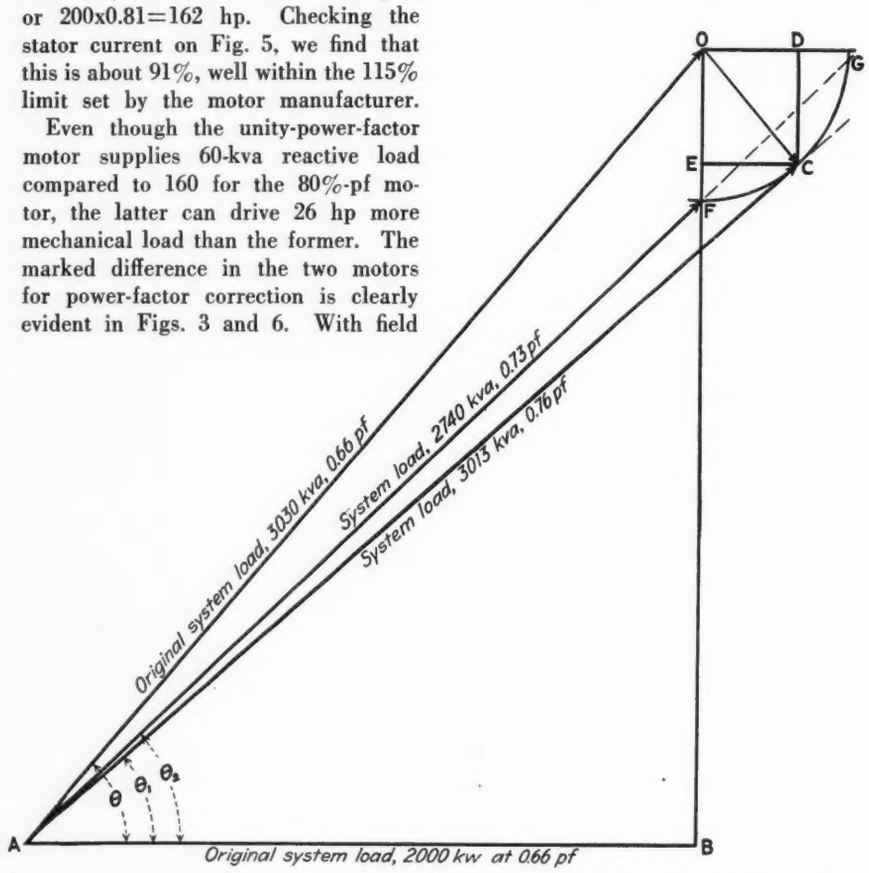
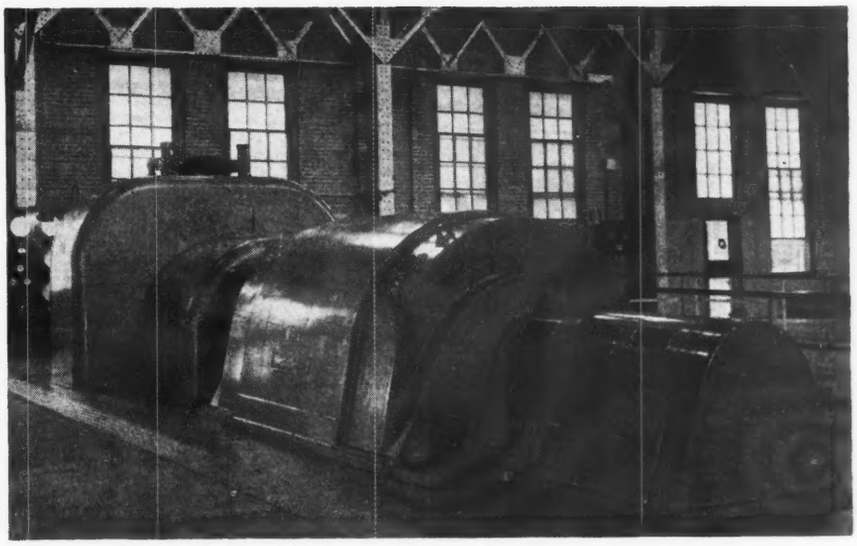



**Fig. 8—Diagram shows how to get maximum power-factor correction with a given synchronous motor**

# 100% Makeup at 825 lb, 750 F

***Youngstown Sheet and Tube installs high-pressure topping units to extend and modernize Indiana Harbor power facilities; modern treating plant supplies 100% makeup to meet exacting requirements of new boilers***



This 10,000-kw turbine exhausts into the 200-lb header supplying existing turbines

► Decision to erect a $15,000,000 hot strip mill, with necessary auxiliary equipment, at the Indiana Harbor plant of Youngstown Sheet and Tube Co brought an expected load increase of about 15,000 kw. An 825-lb, 750-F topping installation now meets increased power demands; an outstanding modern water-treating plant supplies 100% makeup of the quality required for reliable high-pressure operation.

The existing power house contained two 10,000-kw and two 5000-kw turbine-generators, but lacked boiler capacity needed to operate all units at once. In comparing purchased power with a topping installation, only the cost of new boilers and the topping turbine had to be considered in arriving at fixed charges, since there was no need to show a return on the existing investment in generating equipment. Under these conditions, distinctly different from the usual comparison between buying and making power, it was evident that it would be most economical to increase steaming capacity and generate the needed power.

The engineering department calculated expected savings for mill operation at 30, 50, 70, and 90% production, since the cost of power generation would vary with mill output. This procedure gave the management an opportunity to judge which specified percentage of mill operations would most nearly fit expected actual conditions and to judge, therefore, whether investment should be made.

In regard to the choice of equipment, two schemes were considered. One involved installing three high-pressure boilers and no topping turbines; the other contemplated two high-pressure boilers and a topping turbine. Three boilers appealed to the operating man's viewpoint, promising more flexibility and a chance to keep one unit as a spare. The boilers could have been operated at full pressure with reducing valves or at 200-lb, with a proportionately greater output. With two boilers, the units would run at nearly full load most of the time, with no spare and no time for cleaning except when mill operations slacked off. This kept the investment working as nearly continuously as possible and the topping offered a block of additional power at low cost.

### *Boiler Plant*

The economy of the 2-boiler topping-turbine proposal dictated the choice of two 150,000-lb-per-hr boilers, equipped for powdered-coal firing. This gave a combustion-chamber design suited for natural gas, blast-furnace gas, or coke-oven gas, which might be used later. Operating pressure of the boilers was selected so that steam could be expanded through the topping turbine and exhausted into the 200-lb, 500-F low-pressure header with the least attention to desuperheating. Three routes from the high-pressure boilers to the low-pressure header include the topping turbine, two turbine-driven feed pumps and a reducing station.

Two motor-driven pulverizers supply each of the Babcock & Wilcox Integral-Furnace boilers, which are fitted with tubular air heaters. The Bailey air-operated combustion-control system regulates fuel-feed and air supply. To regulate air supply, a control valve in the steam line to the drive turbine controls forced-draft fan speed, and an air-operated control adjusts the position of a louvre damper in the secondary-air duct. Both devices operate in accordance with load requirements as measured by a master steam-pressure controller and they are both automatically adjusted in accordance with combustion requirements as measured by a Bailey boiler meter. The master controller also sends an air-loading pressure to control drives which regulate primary air to each of the pulverizers. A feeder controller on each pulverizer maintains coal level at the correct value for the rate of fuel delivery.

Furnace draft is controlled by positioning the uptake damper and by regulating the speed of the induced-draft fan. As in the case of the air-supply control, these adjustments are made primarily in accordance with boiler load and then re-adjusted to secure the exact draft desired. Manual-automatic selector valves permit remote manual operation of the primary-air dampers for fuel control and of the forced- and induced-draft fans, together with their dampers, at any time. In case of air-pressure failure, direct manual control of dampers and valves can be obtained through operation of hand levers provided on the control drives.

In modern high-pressure power plants, no one considers whether the boiler feedwater should be treated or not, the only question lies in how it shall be treated. This question carried

particular weight at the Indiana Harbor plant since the boilers were designed to operate at a relatively high pressure and temperature and since no condensate returns were available. For construction and preliminary development of a water-treating plant, and for consultation during the first year's operation, the Youngstown Sheet and Tube Co retained Sheppard T Powell, well-known authority.

The first step was selection of a site for the water-treating plant. It so happened that four reheating furnaces adjoined the power-plant site; three were complete and the foundation for the fourth was in place. The decision to use this concrete pad, which restricted the ground-floor dimensions of the treating plant, led to an ingenious, if slightly complicated, layout of the machinery filters, and other accessories.

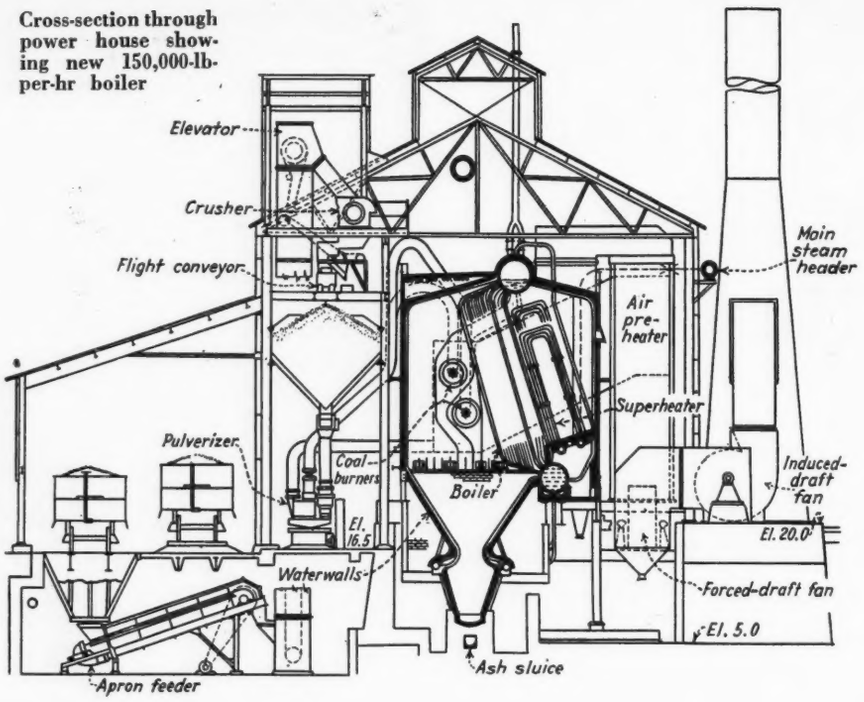
The over-all problem included providing 100% treated water for two boilers operating at 800-lb and also for 25 boilers operating at 200 lb. Although the high-pressure units required better water, it was considered impractical and uneconomical to install two plants to satisfy these requirements, particularly since it was possible that the low-pressure station might be replaced by additional high-pressure units.

Lake Michigan water, highly contaminated by both sanitary and industrial wastes, is the available supply. Considerable quantities of domestic wastes discharge into the lake in the vicinity of the company's intake and the water is also contaminated to an appreciable extent by oil. Part of the supply goes to the mill for cooling purposes.

### *Selecting Feed Treatment*

Three distinct methods of treatment were considered. The first involved preliminary softening and coagulation in a cold-process system, followed by secondary phosphate softening and deaeration in a hot-process softener, and pressure filtration. To prevent accumulation of phosphate deposits in feed pumps, piping, and high-pressure heaters, the pH of the filtered effluent was to be reduced by acid. Internal boiler treatment by means of phosphates was also included.

Advantages of this system included: (1) elimination of an outside deaerating heater, (2) compact installation, (3) recovery of all wash water, (4) low hardness of treated water and corresponding small amount of sludge in boilers. Disadvantages were: (1) lack of flexibility of operation due to the need for complete outage of the secondary softener for repairs as against



Cross-section through power house showing new 150,000-lb-per-hr boiler

an outage of 20-25% of the plant at one time if zeolite units were used, (2) necessity for adding sulphuric acid directly ahead of the feed pump, (3) need for expensive acid feed controls and extremely careful operation, (4) the possibility of acid over-treatment resulting in excessive corrosion, (5) use of pressure instead of gravity filters with increased operating difficulties, and (6) space limitations that would probably necessitate double-deck pressure filters, further complicating operation.

The second scheme consisted of softening by lime and soda and deaerating in a hot-process softener, with coagulation and silica removal by magnesium sulphate. Maximum reduction in hardness was to be effected by return of boiler blowdown to the reaction tank so as to maintain a high soda excess. Double-deck pressure filters would have filtered the effluent and secondary phosphate treatment was to be added directly to the high-pressure boiler drums. While this system would have been somewhat less costly to install and would have required less space, experience with high makeup and boiler pressures was inadequate. In addition such a system would be difficult to control and would provide less flexibility and less complete hardness removal than other plans considered, with the result that larger quantities of sludge would be deposited in the boiler.

The third scheme, the one adopted, involved preliminary softening by lime and soda-ash and coagulation for silica removal, followed by filtration through gravity anthracite units, and complete softening by carbonaceous zeolites. Deaeration in a secondary heater and internal treatment with phosphate, for the high-pressure boilers, completed the system. The most obvious advantage and a large factor in the selection was the complete flexibility provided under all operating conditions. Also, this system insured a minimum residual hardness in the final effluent, eliminating danger of deposits in feed pumps, piping, economizer tubes, etc, and insuring a minimum of sludge deposit in the boiler drums. In addition, relatively large storage of filtered and softened water was provided and the possibility was presented of future conversion of certain of the zeolites from the sodium to a hydrogen cycle, thus affording a reduction in total solids.

### *1,000,000 Lb per Hr*

As installed, the system provides a maximum of 1,000,000 lb per hr of soft, deaerated feedwater. The raw water flows by gravity to an "accelator", a recently developed apparatus in which reaction, flocculation, and sedimentation are carried out. At this point, lime and soda-ash are added to the previously precipitated sludge and the whole intimately mixed with the incoming raw water. Ferric sulphate is added to remove silica and coagulate suspended solids. Clarification proceeds as the water rises through a blanket of sludge, which is maintained at constant elevation and optimum density by intermittent withdrawal. The effluent is taken off through a suitable trough.

From the accelator the partially softened water flows by gravity to a

battery of four 10x18-ft rectangular gravity anthracite filters. Suitable float and orifice boxes discharging into a 30,000-gal clear well beneath the filters, control filtration rates. Filtered water for back-washing comes from a 62,000-gal storage tank, beneath the zeolite softeners. This storage tank is kept full at all times and supplements the filtered-water clear well if the level in this compartment drops below the proper point.

To reduce alkalinity and pH of softened filtered water prior to final softening by the carbonaceous zeolites, sulphuric acid was originally added directly to the clear well beneath the filters and mixed with the water by a series of baffles, the pH of zeolite influent being maintained between 7.0 and 8.5. An acid mixing section in the pipeline discharging filtered water to the zeolite units now replaces this original arrangement.

Pumps lift the acid-treated filtered water to a battery of five gravity zeolite softeners (10 ft in diameter by 12 ft high) and these in turn discharge into a steel-lined 18,600-gal storage tank, beneath the pump room. Filtered acid-treated water from this tank serves for backwashing the units. Washwater from both zeolite and anthracite filters flows to a sump from which it may go either to the sewer or to the inlet chamber of the accelator. Acid-treated filtered water is used for rinsing the softeners and is then discharged directly to the sewers. Float and orifice boxes control back-washing and rinsing rates.

From the soft-water storage tank, pumps take the water to a deaerating heater and storage tank. Adding sodium sulphite at this point removes all traces of oxygen and maintains an excess of sulphite in the boiler water. Deaerated water is then pumped to the low-pressure generating station, or through a high-pressure heater to the new boilers. Disodium phosphate is added directly to the top drum of the high-pressure boilers in order to precipitate, as a sludge, any traces of hardness still remaining.

Continuous blowdown discharging into flash tanks in the 200-lb and 3-lb systems controls concentration of solids in the boiler water. Residual blowdown water passes through a heat exchanger, imparting heat to the soft water on its way to the deaerator, and then to the sewer.

All chemicals used in the treating process are proportioned to the flow to be treated. Lime, soda, ferric sulphate and acid depend on raw water flow to the accelerator; sodium sulphate depends on flow to the deaerating heater, and phosphate depends on flow of boiler feedwater.

The water-treating plant, as a whole, was contracted from the Dravo Corp, and, with the exception of the accelator and its chemical feeders, which came from the International Filter Co, the equipment was supplied by Cochrane Corp. Operation began in September, 1939.

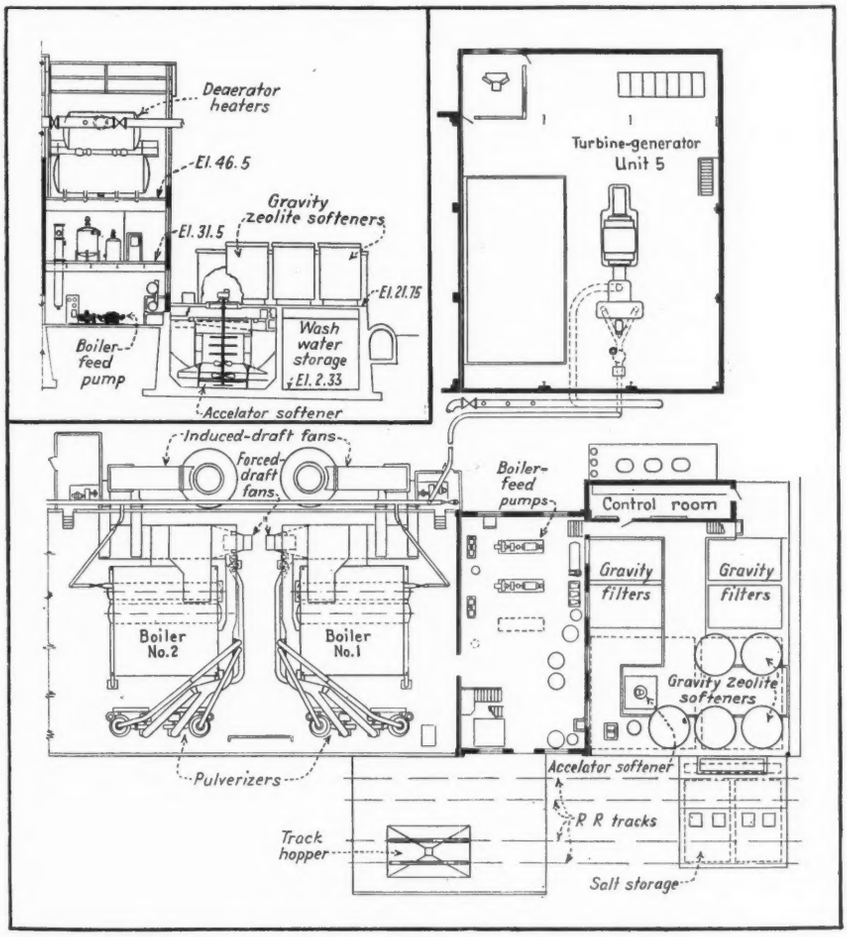
### *Operating Problems*

In operating a plant of this type, numerous difficulties must be anticipated. Until recently, it was difficult to maintain the chemical feed to the accelator proportional to raw water flow when sudden changes in load occurred. Operators discovered that when acidified wash water returned to the flocculating compartment for re-treatment, as originally planned, the sudden heavy flow upset the sludge equilibrium and was usually followed by the passage of large quantities of highly turbid water to the filters. Consequently, the wash-water return line was closed off and all water directed to the sewer.

Difficulty was also experienced with the acid feeding system and at times the pH of the influent to the zeolite softeners was so high as to cause apprehension over possible deterioration of the zeolite material. It is now proposed to add the acid at a different point, where more adequate mixing is available and, in addition, certain changes have been made to the acid-feeding equipment.

Excessive time required to regenerate zeolite softeners made operation difficult, but later modifications have improved results. Continuous feeding of sufficient phosphate to precipitate residual hardness after zeolite softening was hindered by poor operation of solenoid valves controlling phosphate feed. New valves, better protected from the phosphate solution, remedied the situation.

On the whole, considering the complexity of the system, plant operation proved satisfactory and the condition of boiler surfaces at each inspection demonstrates that despite a number of difficulties and annoyances encountered, the feedwater has continued of excellent quality. Various small changes planned by the engineers and the manufacturer's service departments are expected to eliminate largely the difficulties mentioned.




**Layout of boilers, turbines and accessories; inset at upper left shows elevation of water-treating set-up and auxiliary heaters and pumps at end of boiler house.**

# Fundamentals of Diesel Heat Recovery

***The two-thirds of a diesel's fuel input that "goes up in smoke" offers tempting opportunities to the Btu-minded engineer. Glenn C Boyer, Burns & McDonnell Engineering Co, gives the basic data needed to figure waste-heat-recovery possibilities***

▶ THE PRESENT-DAY DIESEL, producing a brake-horsepower from 7500 to 8000 Btu of fuel input, is the most efficient prime mover the power engineer knows. This naturally leads to its application where efficiency in producing mechanical power is paramount and where little or no emphasis is placed on "by-product heat." Nevertheless, the two-thirds of the diesel's fuel input that "goes up in smoke" offers tempting possibilities for various kinds of auxiliary heating in diesel central stations and for process heating in industry. To miss no bets, power engineers should study *every* diesel job to make sure no economical chance for heat recovery is lost.

The starting point of such a study lies in a knowledge of the amount and kind of heat available from a diesel engine, and what factors affect it. In converting the heat energy of liquid fuel into mechanical energy, only about one-third of that available finally shows up as useful mechanical energy, the remainder appearing in the exhaust, in the cooling water, and in radiation from the engine itself. The heat supplied to a modern mechanical-injection diesel, rated at 125 hp per cylinder, can be accounted for as shown in Fig. 1 and Table I.

To determine how and where diesel waste heat can be put to work, the engineer must know: (1) heat balance for the particular engine involved, (2) fuel-oil consumption at full and fractional loads, (3) cooling-water temperatures on and off the engine, at full and fractional loads, (4) exhaust-gas quantities at full and fractional loads, and (5) exhaust-gas temperatures at full and fractional loads.

### *Typical Heat Balance*

The typical heat balance given represents average results with reasonable accuracy, although the percentage distribution will vary slightly for various

**Table I—Typical Diesel-Engine Heat Balance**

*Mechanical-injection, 125 hp per cyl*

| Engine Load | *1/4* | *1/2* | *3/4* | *4/4* |
|---|---|---|---|---|
| Useful Work, % | 26.0 | 32.0 | 33.5 | 34.5 |
| Cooling Water Loss, % | 24.0 | 27.0 | 29.0 | 30.0 |
| Exhaust and Radiation Loss, % | 26.0 | 26.0 | 26.0 | 27.0 |
| Mechanical Losses, % | *24.0* | *15.0* | *11.5* | *8.5* |
| Total Heat Energy of Fuel, % | 100.0 | 100.0 | 100.0 | 100.0 |

**Variation in Heat Input to Diesel Engines**

| Engine Load | *1/4* | *1/2* | *3/4* | *4/4* |
|---|---|---|---|---|
| Btu per Brake Hp Hr (maximum) | 11,790 | 9500 | 8550 | 8160 |
| Btu per Brake Hp Hr (minimum) | 10,000 | 8160 | 7600 | 7400 |

These figures apply to most commercial engines in the size ranges usually found in stationary practice.

**Table II—Air Requirements for Typical Diesel Engines**

| *Type of Engine* | *Air required at full load: lb per lb fuel* | *lb per hp hr* |
|---|---|---|
| 4-cycle, solid-injection | 25–32.5 | 10–13 |
| 4-cycle, air-injection | 30–37.5 | 12–15 |
| 2-cycle, solid-injection, pump-scavenging | 55–58.7 | 22–23.5 |
| 2-cycle, solid-injection, crankcase-scavenging | 45 | 18 |

**Theoretical Quantity of Air for Combustion of Oil**

| *Source of Crude* | *Specific Gravity* | *Btu per lb* | *Lb air per lb oil, theoretical* |
|---|---|---|---|
| Texas | 0.907 | 19,230 | 14.15 |
| Mid-Continent | 0.892 | 19,376 | 14.00 |
| California | 0.971 | 18,820 | 14.08 |
| Mexico | 0.986 | 18,720 | 13.32 |

(These figures are from "Economic Utilization of Natural Gas," by Davis, Ihrig, Sabin and Terry, Transactions AIMME, 1931, p 388)

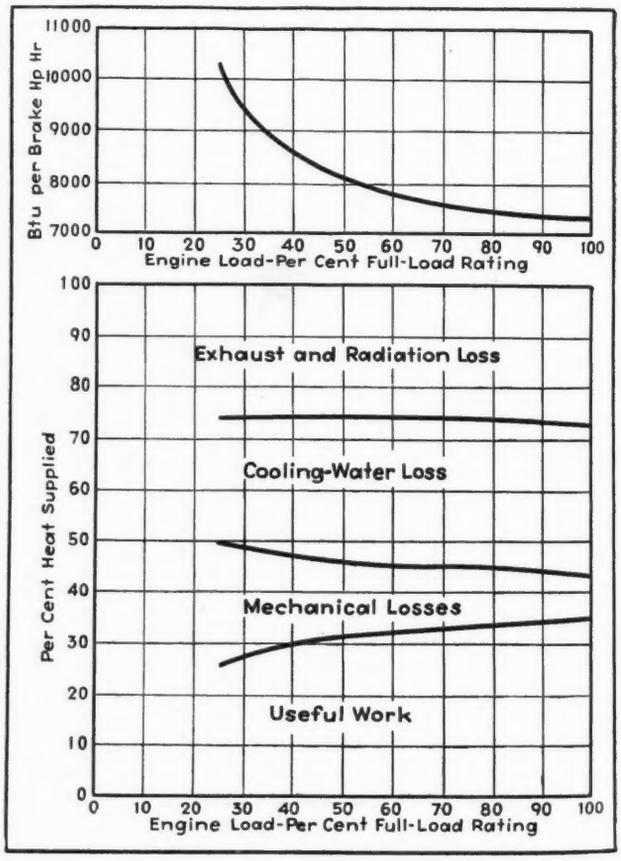

Btu per Brake Hp Hr
11000
10000
9000
8000
7000
0 10 20 30 40 50 60 70 80 90 100
Engine Load-Per Cent Full-Load Rating
Per Cent Heat Supplied
Exhaust and Radiation Loss
Cooling-Water Loss
Mechanical Losses
Useful Work
100 90 80 70 60 50 40 30 20 10 0
0 10 20 30 40 50 60 70 80 90 100
Engine Load-Per Cent Full-Load Rating

Fig. 1—Typical diesel-engine heat balance—mechanical-injection engine rated at 125 full-load hp per cylinder

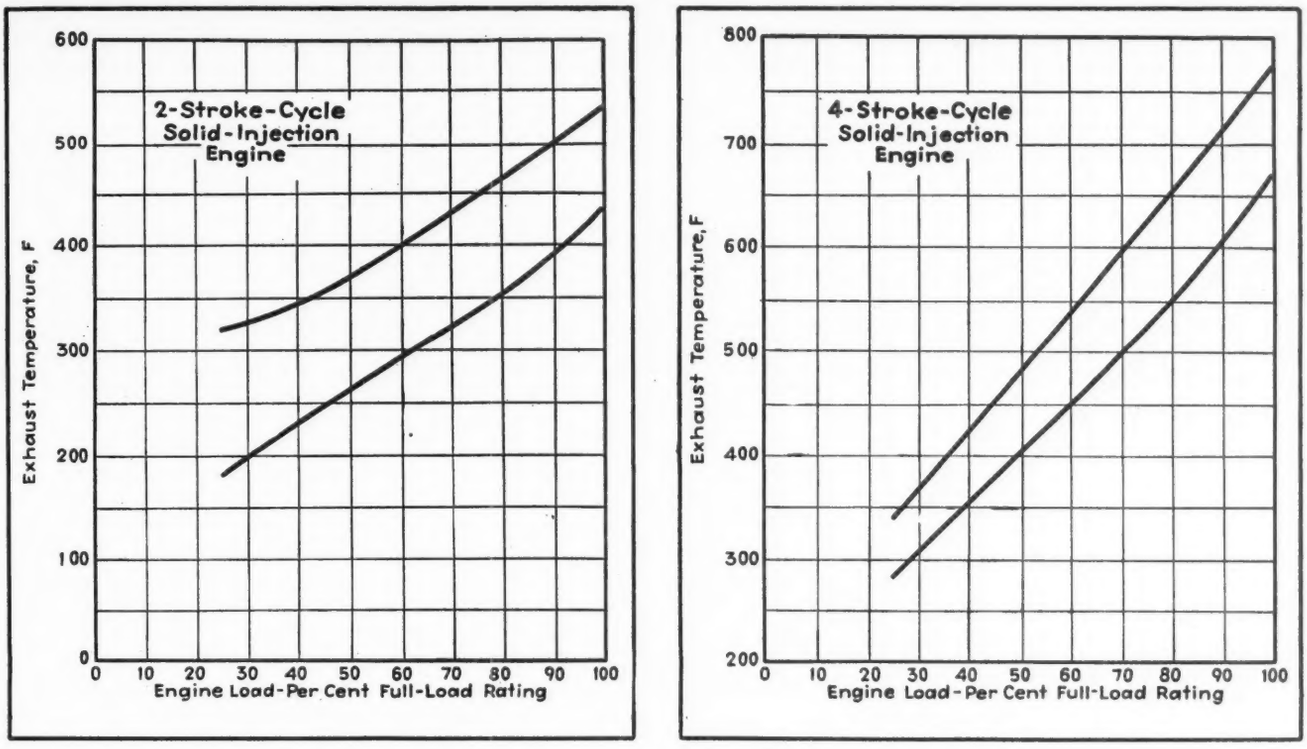



**Fig. 2—Range of exhaust-gas temperatures for typical 2- and 4-cycle engines**

makes, types and sizes of engines. No important error would be involved in using this typical heat balance for preliminary calculations, if data for a specific engine were not available. In Fig. 1, the area between the curve of useful work and the 100% line represents waste heat. However, that part appearing as "Mechanical Losses" cannot be utilized except as it appears as sensible heat for warming the engine room. For general waste-heat recovery purposes, heat in the cooling water and in the exhaust are the main and only sources. At full load they represent more than 50% of the heat supplied to the engine, and the percentage stays fairly constant from half to full load.

Where possible, fuel-oil guarantees for the engine under consideration should be used in figuring waste-heat possibilities, but if not available for preliminary calculations, the average figures given in Table I can be used. By utilizing heat balance percentages and fuel-consumption figures or Btu-input data, the engineer can calculate the *amount* of heat available in both cooling water and exhaust gas.

### *Jacket-Water System*

Cooling-water temperatures depend on the design of the jacket-water system. A temperature of 115 to 120 F (off the engine) is generally considered the upper limit for an open cooling system. Most engine builders supplying units for stationary service recommend an upper limit of about 150 F for closed-system operation. The temperature rise between cooling-water inlet and outlet will vary from 10 to 30 F, with the present tendency toward the lower figure. Some engineers claim improved engine performance if cooling water off the engine runs in the neighborhood of 150 to 165 F and the temperature rise is held to 10 F.

### *Uses for Jacket Heat*

Determining the general arrangement of the jacket-water system thus fixes within reasonable limits the temperature of the jacket water. The water temperature rise allowed in passage through the engine in turn fixes the amount of water that must be circulated. The amount of surface required in a closed-system heat exchanger will depend on these factors (amount and temperature of water circulated) and on the terminal difference selected. This the engineer must determine, either to give the desired hot-water temperature, or, if that is not a limiting factor, to give the most economical size of heat exchanger. Obviously, the low temperature at which jacket-heat is available restricts the range of uses to which it may be put directly. However, the opportunity to use jacket heat for preheating must not be overlooked.

The quantity of exhaust gas available from a diesel engine depends on the amount of air passed through the engine for combustion and scavenging purposes. Engine design fixes this quantity, but for a particular design the weight of air will vary, depending on the inlet temperature and barometric pressure. The total quantity of air supplied to any diesel engine remains practically constant at all loads.

Table II shows quantities of air required, at full load, by various types of engines. These are based on standard temperature and barometric pressure conditions and so are subject to variation due to local differences. The table also shows the theoretical weight of air required for the combustion of 1 lb of fuel oil. It is readily apparent that the quantity of air required by a diesel is considerably in excess of the theoretical amount required for combustion of the fuel. It is also apparent that a 2-cycle engine requires about twice as much air as a 4-cycle unit.

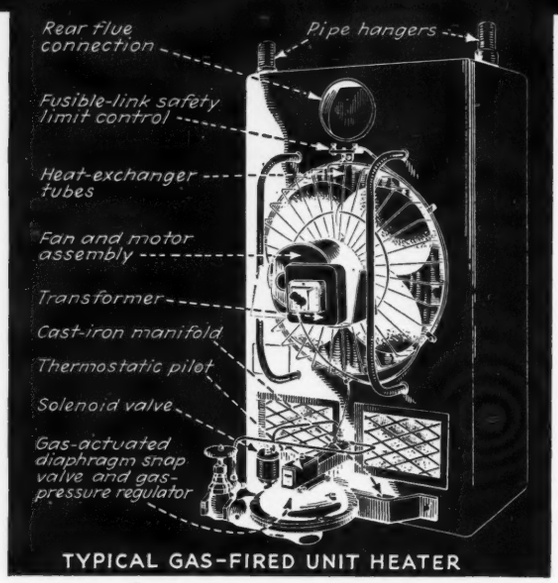
### *Temperature Variation*

In addition to knowing the quantities of gas discharged through the exhaust in a given time, one must also know the variation in exhaust-gas temperature at various engine loads. Figs. 4 and 5 give this data for 2- and 4-cycle solid-injection engines. Exhaust temperatures for air-injection engines will run somewhat lower, since these units need, in general, more air per pound of fuel.

The curves indicate higher exhaust temperatures for 4-cycle engines. Here, again, the reason lies in the fact that the average 4-stroke unit uses less scavenging air. Where steam is wanted, the higher temperature of the 4-cycle exhaust gives it an edge over the 2-cycle.

# Modern Unit Heaters

***"Packaged forced-warm-air systems" offer flexible, efficient, and low-cost heating for a wide range of applications. Here's the how and why, along with practical data on today's units***



TYPICAL GAS-FIRED UNIT HEATER

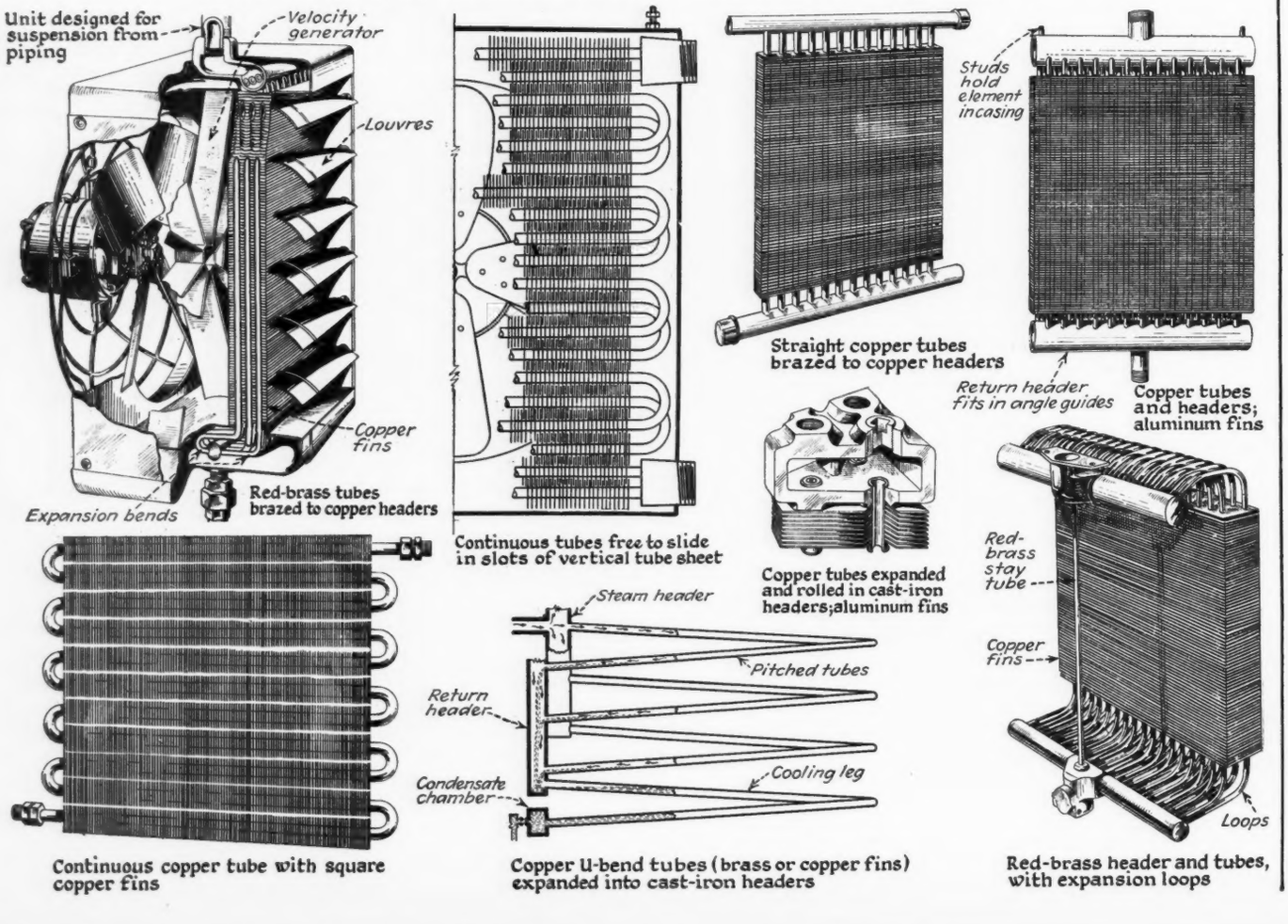
▶ BACK IN THE EARLY 20's, a pioneering engineer combined a fan and a heating element in a cabinet to form the first "unit heater". In less than 20 years, designers have changed the original clumsy units into today's sleek and efficient devices and mass production has brought prices down sharply. As a result, unit heaters now find wide application in all phases of heating and ventilating, but particularly in the industrial field.

Unit heaters gained acceptance by offering three major advantages: economy, improved performance, and flexibility. These come from the combination of two basic ideas: the "packaged" mass-produced unit and forced air circulation. Mass manufacture permits spreading research and engineering costs over a large number of units with the result that a standardized forced-circulation unit can be produced to compete with other heating systems. To some extent also, factory fabrication reduces installation cost by decreasing the number of parts to be assembled on the job.

### *High Heat Transfer*

Forced circulation makes possible vastly higher heat-transfer rates (8-10 times) which means a smaller, lighter, cheaper heating element for a given job. Use of a fan contributes positive circulation in the heated space, difficult to attain with gravity systems. Better circulation reduces the temperature differential between floor and ceiling, largely preventing the cold layer of air commonly found on the floor level. Control over direction of heated air means better regulation of temperature over the space to be heated and the elimination of both cold spots and overheated areas where heat is wasted. Forced circulation and high heat transfer rates mean quick "pick-up". Easy application of thermostatic control backs up these gains from forced circulation. Taken together,

**TYPICAL HEATING ELEMENTS FOR PROPELLER-FAN UNIT HEATERS**


Unit designed for suspension from piping
Velocity generator
Louvres
Copper fins
Expansion bends
Red-brass tubes brazed to copper headers
Continuous tubes free to slide in slots of vertical tube sheet
Straight copper tubes brazed to copper headers
Studs hold element in casing
Return header fits in angle guides
Copper tubes and headers; aluminum fins
Copper tubes expanded and rolled in cast-iron headers; aluminum fins
Red-brass stay tube
Copper fins
Loops
Steam header
Pitched tubes
Return header
Cooling leg
Condensate chamber

Continuous copper tube with square copper fins

Copper U-bend tubes (brass or copper fins) expanded into cast-iron headers

Red-brass header and tubes, with expansion loops

they mean improved performance from the standpoint of comfort and fuel economy.

Flexibility represents a practical reason for wide use of unit heaters, particularly in industrial plants. Units or combinations of units can be arranged to meet almost any condition, such as unusual exposure, hard-to-heat corners, open doorways, etc. Unit heaters require little wall or head room and are often suspended from roof trusses, completely out of the way. Piping and control equipment, is, in general, simple and easy to install and can be both inconspicuous and yet readily accessible for servicing. Changes in unit heater locations can be made with a minimum of trouble.

Originally designed for factory heating, increased quietness and improved appearance have brought unit heaters acceptance in the commercial field as well. Today we find them in stores, display rooms, garages, factory offices, and industrial buildings of all kinds. In addition to space or comfort heating, unit heaters find application in the drying of fabrics, chemicals, ceramics and many other products, in eliminating fog, vapor, and condensation in packing plants, dairies, paper mills and dye houses; and in killing moths, and weevils by heat.

### *Rating Unit Heaters*

The basic rating for unit heaters is expressed in Btu per hr. Since this figure depends on entering air temperature and on steam pressure as well as on the fan and heating-element capacities, manufacturers have agreed to standardize ratings at 60 F entering-air temperature and 2 lb steam pressure. Most capacity tables give values for other entering-air and steam-pressure conditions and correction factors for interpolation. In addition, most capacity tables give sq ft of equivalent direct radiation, cfm handled by fan, final temperature of air, condensation in lb per hr, outlet velocity in fpm, motor rpm, noise rating in decibels, hp at maximum rpm, watts input, and amps.

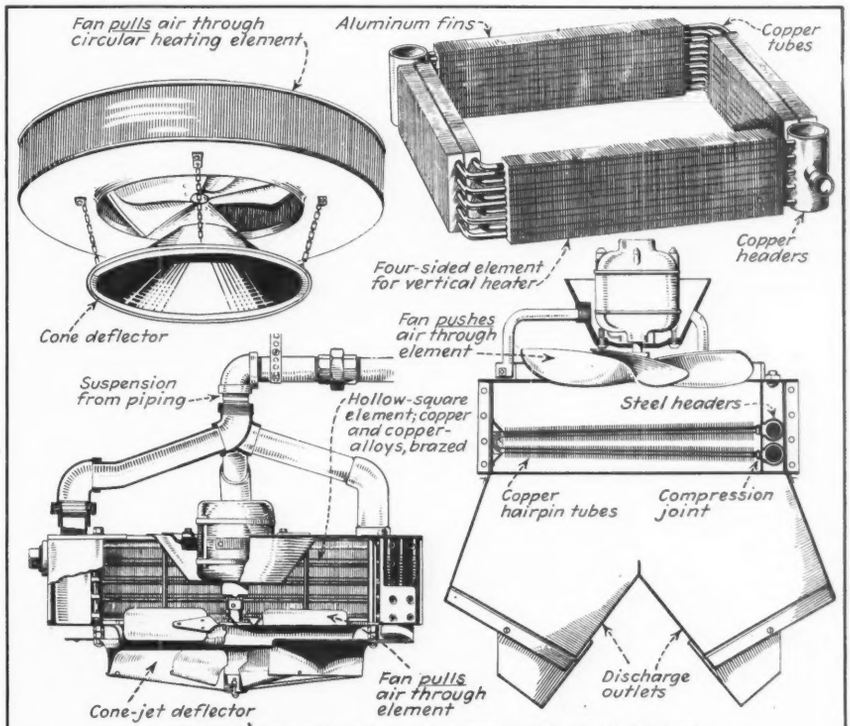
Unit heaters fall into three major types which differ in construction and in range of application: (1) the suspended, propeller-fan unit, (2) the vertical, high-velocity unit, and, (3) the housed centrifugal-fan unit. Historically, the first and third types came first, with the vertical high-velocity heater as a later development combining features of both. No single type will meet all heating problems and the special usefulness of each can be better understood after a consideration of construction and performance characteristics.

Propeller-fan units consist of an extended-surface heating coil mounted in a suitable steel housing with a direct-motor-driven fan mounted behind; the fan forces air over the coils and out through louvres which control the direction of the air stream. For large capacities, two, or even three, fans may be mounted side by side behind two or three heating coils, all in a single housing. Propeller-fan units can be obtained in sizes ranging from about 15,000 Btu per hr to close to 500,000; or in terms of equivalent direct radiation, from about 75 sq ft to 1500. Air volume handled ranges from 300 to 5000 cfm. These figures are based on single-speed units, or on the upper speed level of 2- or 3-speed motors. Outlet velocity, for normal-speed operation, ranges from 650 fpm to 1250.

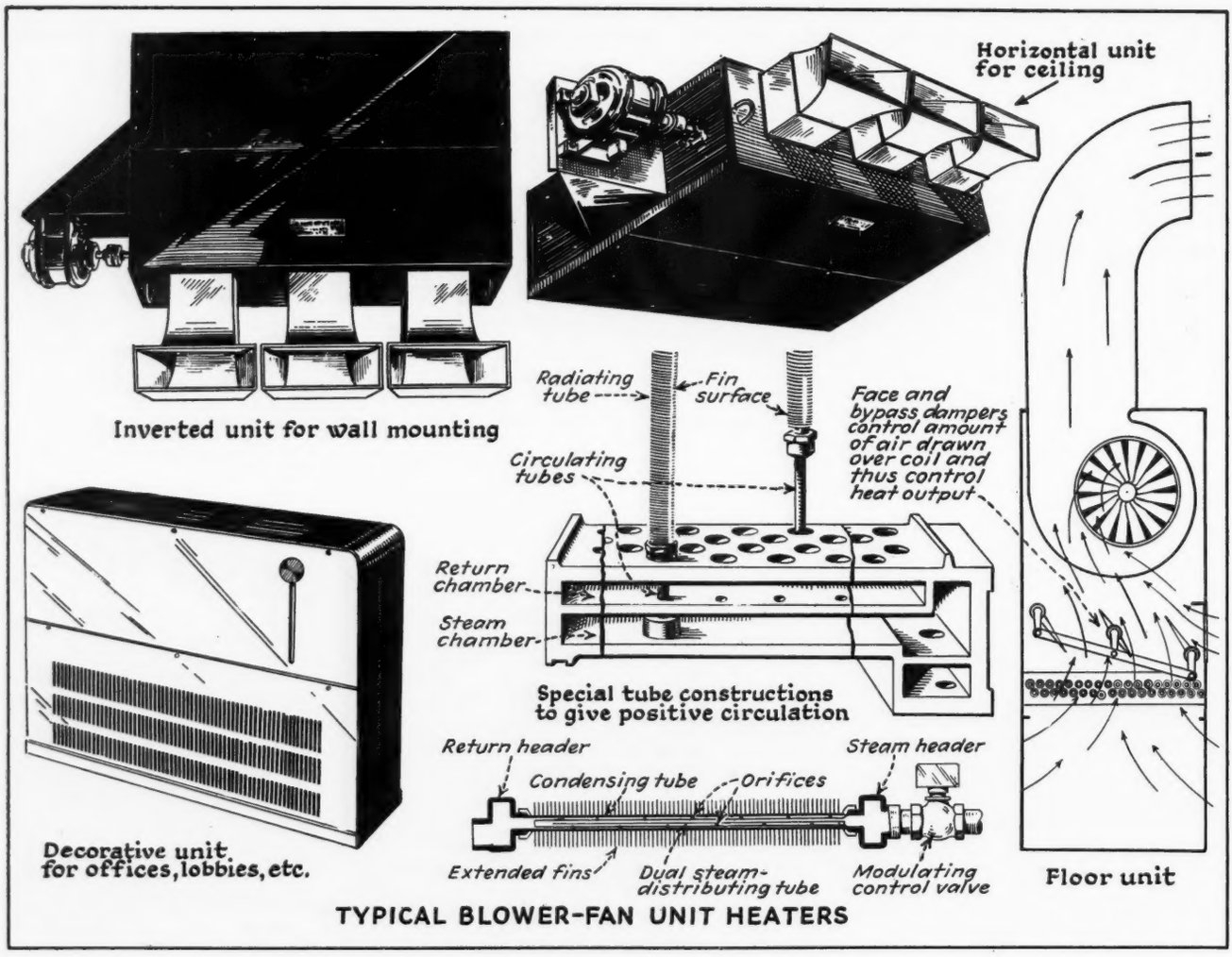
Unit heaters are subject to quick temperature changes, particularly where "on-off" control is used, so designers place emphasis on heating-coil construction that will compensate for expansion and contraction. Diagram at left shows typical heating elements: these include continuous coils, without headers; hairpin or U-bend coils, with a single header; tubes with expansion bends, running between fixed headers; basically straight tubes, running between a fixed and a sliding or movable header. Tubes are nearly always copper; extended surface may be copper, brass, or aluminum for lightness. Header construction varies; most makers use tubular headers of copper, bronze or brass with tubes brazed in place. At least two makers use cast-iron headers with tubes expanded and rolled. Most heating elements can be operated at pressures considerably above normal heating system pressures, but if a unit is desired for operation on live steam, the manufacturer's specification should be checked for the exact upper limit. Special heating elements, with wide-spaced fins, meet conditions in textile mills and similar locations, where the air contains lint, etc.

Fan designs vary widely but all aim at high velocity and output with minimum noise. In addition to shaping fan blades to move air quietly, some designers stress other noise-reduction efforts such as allowing ample spacing between fan and heating element, to permit air stream to spread; velocity generators to reduce peak velocity at given spots in the heating element; venturi-shaped fan shrouds; acoustically insulated casings. The success of any fan design or other noise-reduction effort can best be measured by comparing guaranteed noise ratings, in decibels.

Normally, propeller-fan heaters come equipped with adjustable horizontal louvres, which permit control of air-stream direction. Fixed, downward deflecting grilles may be used for better



TYPICAL VERTICAL UNIT HEATER CONSTRUCTIONS




TYPICAL BLOWER-FAN UNIT HEATERS

appearance, or discharge hoods may be provided where a direct downward flow of air is desired. Another method of securing downward flow involves suspending the heater horizontally instead of vertically, with suitable nozzle outlets. Since propeller fans work best under low-resistance conditions, fitting duct work to the outlet will reduce capacity.

There are two general methods of suspending propeller-fan unit heaters: by hangers fastened to the casing or by the piping connections. Naturally the latter only applies to heaters specifically designed for such suspension. Inserting unions in the supply and return lines permits rotating the heater through a full circle, to secure the desired direction of flow.

Other heating mediums than steam are sometimes employed. Most steam unit heaters can be used for forced-hot-water operation, if suitably piped, and at least one manufacturer makes heaters with surface designed for hot water. Because of the lower rate of heat transfer and the lack of latent heat, hot-water surface has a tube-to-fin-surface ratio of 1 to 3 instead of 1 to 8 for steam. For regular steam-heating units, capacity on hot water will be lower, depending on the water temperature.

Gas-fired and electric unit heaters solve many special heating problems. A typical gas-fired unit is shown on page 72. Burners, located in the bottom of the casing, fire up into heat-exchanger tubes, over which the fan forces the air to be heated. Whether or not a flue for combustion products is required depends on the size of the space heated, but provision of a flue seems good practice in permanent installations. Typical electric units differ from steam units largely in the heating element, formed of strip heaters mounted to allow for expansion.

### *Vertical Units*

Vertical unit heaters differ from those previously described in both arrangement and performance. As can be seen from Fig. 3, illustrating typical units, the fan lies in a horizontal plane and may draw air through the element instead of *pushing* it through. Higher outlet velocity produces greater "throw". Use of a downward-moving "cone" of air, instead of a stream moving horizontally or at a slight downward angle, permits installing the heater much higher than the conventional propeller-fan unit, desirable where use of traveling cranes or other equipment makes it necessary to put heaters above roof-truss members. A variety of outlets can be fitted to vertical heaters to allow installation under low ceilings and to give close directional control. A more detailed analysis of characteristics of heaters of this type will be given in a later article dealing with selection and installation.

Housed centrifugal-fan units offer high capacity for heating large spaces with a minimum number of units. The centrifugal fan works better against resistance than does the propeller type, so high outlet velocities are possible. This, in turn, gives longer "throw", better circulation, and greater capacity. Units of this type can be had in sizes up to about one and a quarter million Btu per hr, 20,000 cfm, and 5000 sq ft of equivalent direct radiation.

Where floor and wall space is available, the floor unit above represents a good answer, since installation is simple and since return air is drawn from a low level, keeping the floor-

*(Continued on page 136)*

# New Boiler—No Shutdown at Toledo Pumping Station

***Broadway plant now carries entire load on water-cooled-stoker boiler that required no curtailment of service during installation, reports E M Wilgus, Dept of Public Service, Toledo, Ohio***

▶ CONTINUOUS OPERATION is indispensable for a high-pressure pumping station that represents the only means of maintaining pressure in a water-distribution system. Shutdown for even a minute or two is out of the question where no elevated tank or secondary supply is available. This requirement, together with existing building limitations, dictated working out designs and a construction program that would not jeopardize service.

### *Continuous Operation*

While construction is now under way on a new electric-motor-driven high-pressure pumping station in connection with the new Toledo Lake Erie Water Project, the Broadway station is the only present source of high-pressure supply. Its continuous uninterrupted operation is, therefore, indispensable. After the new Lake Erie station is in operation, the Broadway plant will be maintained as an emergency standby and will also continue its present function of supplying about 16,000 lb per hr of heating steam for the Toledo Zoological Park during winter months.

Remodeled in 1914, the pumping station has been kept in fairly good repair. Two 5000-sq-ft McNaull boilers, however, had been condemned by the State Boiler inspector and almost continuous service had begun to take toll of the battery of Stirling boilers installed in 1917. No provision for extending the boiler room had ever been made, nor was room available in the existing structure for added steam-generating equipment. Surrounding grounds and appearance of the building would hardly permit, architecturally, of an extension large enough for a complete new boiler installation.

Removal of one of the old McNaull

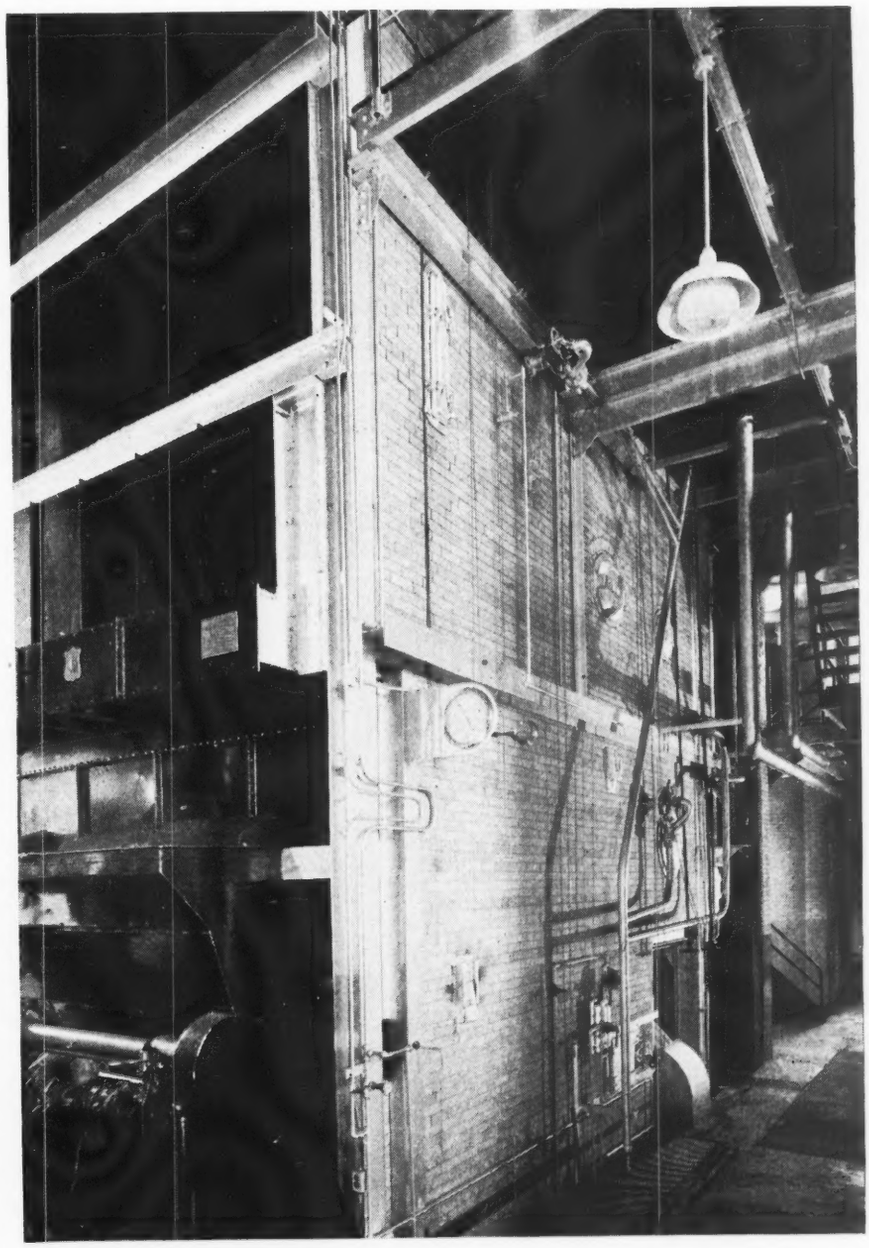


**Fig. 1—New steam generator occupies space of one boiler of condemned twin-set battery. Other old boiler stood by during construction**

boilers and erection of a small building extension sufficient to house new auxiliary equipment seemed the best solution. The remaining McNaull was kept available as standby for the Stirlings during construction of the new unit.

No provision for increase in pumping capacity was required as the new electric station will soon be completed. The new 45,000-lb-per-hr boiler can carry continuously the highest pumpage previously experienced (near the capacity of the station). Present pumping equipment consists of two 30-mgd turbine-driven centrifugals, one 30-mgd triple-expansion unit and two 15-mgd vertical-compound pumps.

The turbine-driven units are designed for 200-lb steam pressure and 150-F superheat, but the reciprocating units can use only 150 to 160 lb steam without superheat. Present operation is at 150-lb without superheat to accommodate the reciprocating pumps and the new boiler also will operate at this pressure as long as the old reciprocating pumps are needed for capacity. The boiler is designed for 250-lb pressure and provision made for future installation of a superheater so that the centrifugal units can take advantage of the higher steam conditions after the reciprocating pumping units have been retired from service.

It would have been possible to provide a pressure-reducing and desuperheating station to permit simultaneous operation of the reciprocating units at 150-lb and the centrifugal units at 200-lb pressures, but cost was high.

Fuel-burning equipment selection required considerable study as space would not permit installation of pulverized-fuel firing. A water-cooled stoker was considered to require least maintenance under continuous high load, such as will be required of the new boiler, and was considered to maintain highest efficiency under these conditions, while burning Ohio coal.

Stoker mechanism is turbine driven from a small unit mounted directly on the stoker. Shaft connections and clutches allow this turbine to drive the stoker shaft of the old Stirling boilers. An emergency drive, one of the old vertical fan engines, is in the basement,

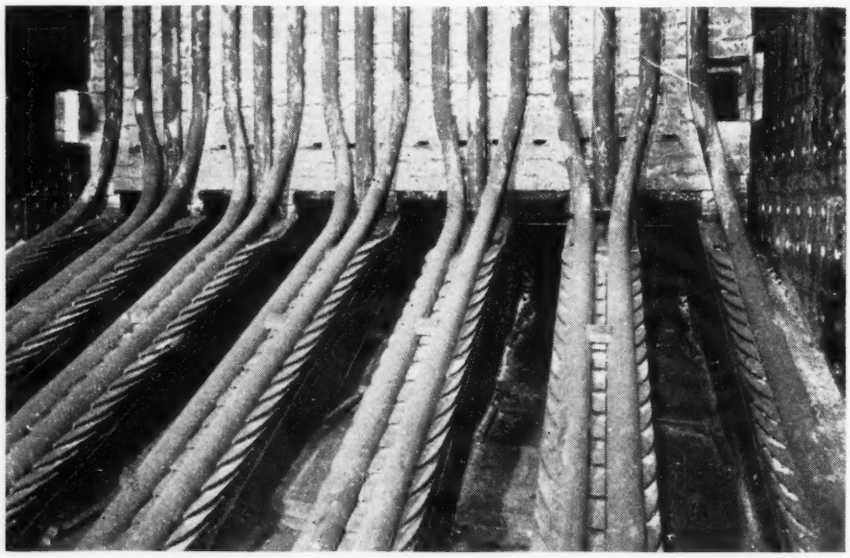


**Fig. 2—Water-cooled stoker for 45,000-lb-per-hr boiler will have to carry full load most of the time so that minimum maintenance is a primary factor**

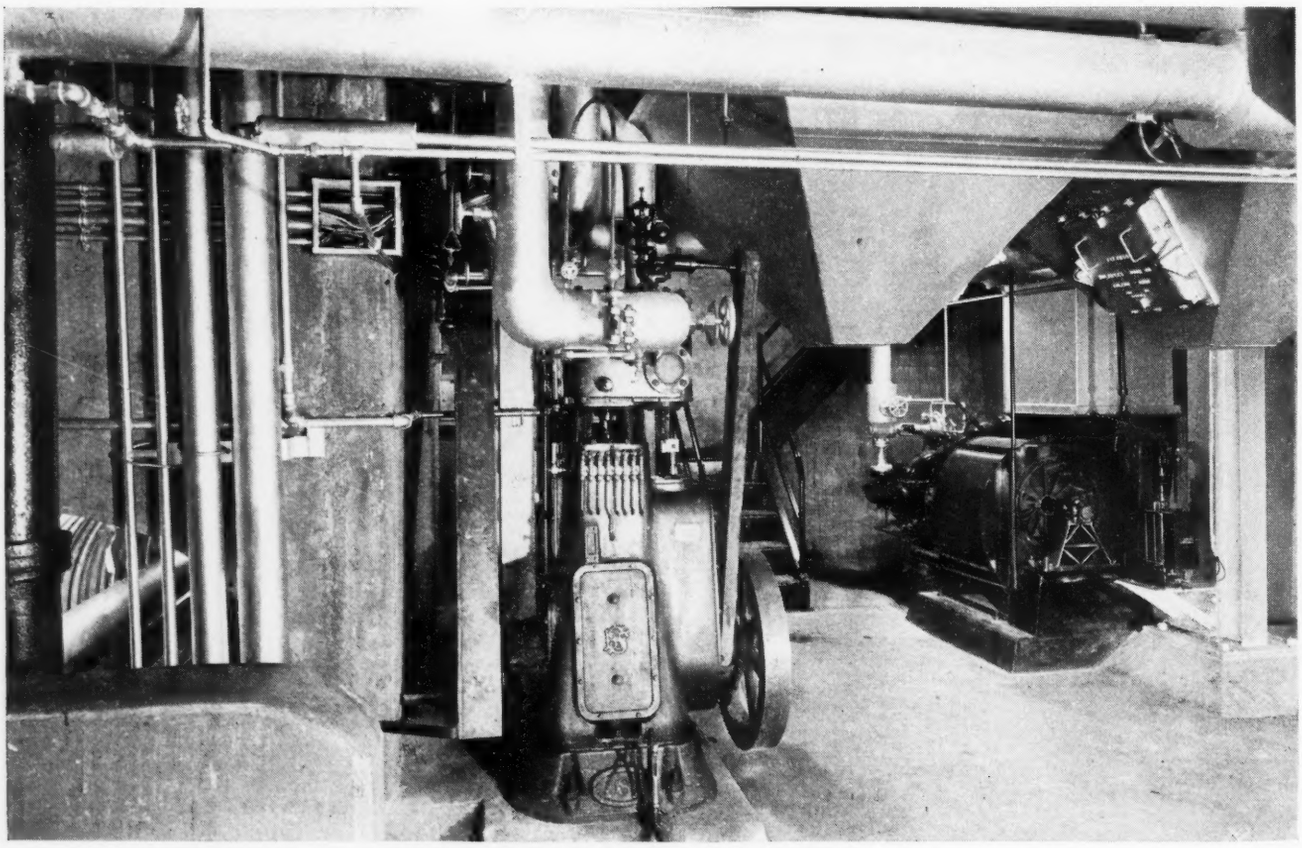


**Fig. 3—Relocated vertical fan engine serves as emergency stoker drive. New forced-draft fan and siftings hoppers at rear**

## PRINCIPAL NEW POWER EQUIPMENT

### *Broadway High-Pressure Pumping Station*

| | |
|---|---|
| Boiler, 7000 sq ft heating surface | Babcock & Wilcox Co |
| Design pressure 250 lb, saturated, bent-tube, 4-drum | |
| Stoker, underfeed, water-cooled | American Engineering Co |
| Combustion control | Bailey Meter Co |
| Boiler-feed pumps | Worthington Pump & Machinery Corp |
| Feedwater heater | Worthington Pump & Machinery Corp |
| Feedwater treatment | Wm B Scaife Co |
| Forced-draft fan | Buffalo Forge Co |
| Fan-drive turbine | Moore Steam Turbine Co |
| Boiler-feed-pump drive turbine | Moore Steam Turbine Co |
| Stoker-drive turbine | Terry Steam Turbine Co |
| Feedwater control, drum level (Copes) | Northern Equip Co |
| Pump governors | Northern Equipment Co |
| Ash hopper | Beaumont-Birch Co |
| General contractor | J A Young Co |

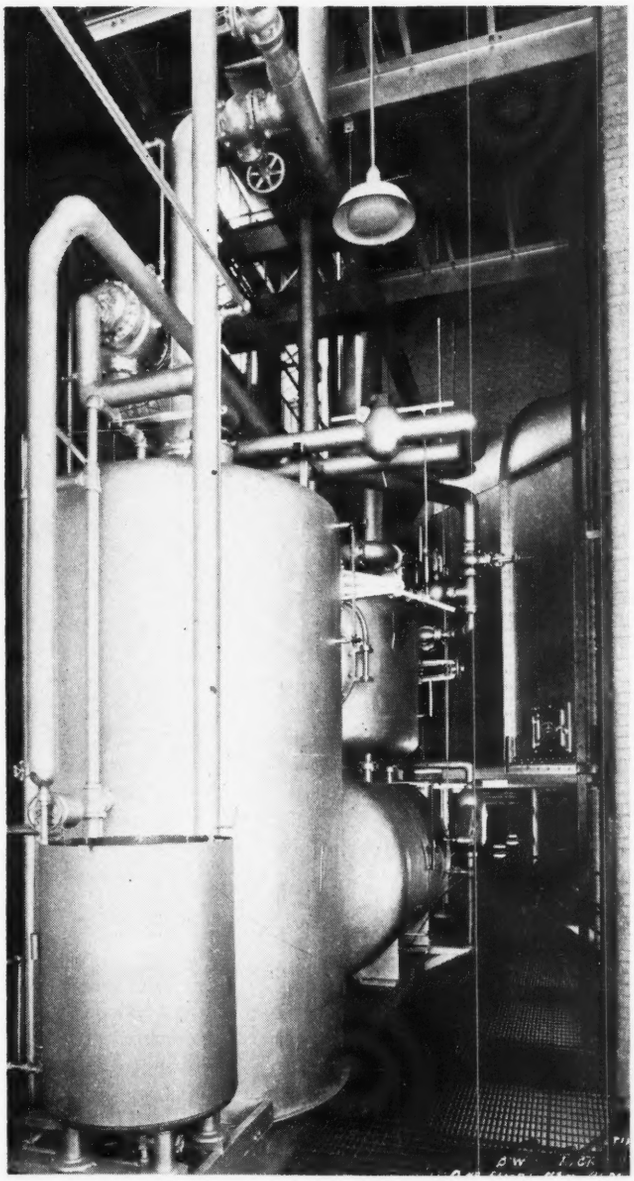


Fig. 4 — Feedwater heater and chemical tank occupy upper part of building extension

Fig. 3. A roller chain and clutch sprocket connect the engine with the stoker drive shaft and allow disengagement when the shaft is normally being driven by the turbine unit.

A new forced-draft fan can carry full load, but in addition air for combustion can be supplied from a turboblower or one of the old engine-driven fans.

To avoid interruption of pump operation, the construction program was carried out in three separate steps. First, a contract was awarded for construction of the building extension at a cost of $22,696. Second, the feedwater pumps, feedwater heater, new return tank and feed treatment plant were installed, pipe work started and old mechanical equipment removed to make ready for the boiler, at a cost of $28,980. Third, all excavation, foundations, new boiler and stoker work in the main boiler room were contracted for. One contractor was made responsible for the contract involving the boiler installation itself. completed at contract cost of $76,822.

After three months operation, it can be reported that equipment is operating satisfactorily with no "hitch" in the starting-up program due to faulty equipment. Use of an old compressed-air pump to supply combustion-control regulators did, however, result in pumping oil into the new lines and throwing regulators out of adjustment. A new air-compressor corrected this trouble.

The installation was constructed as a PWA project under the general direction of Mr G N Schoonmaker, city manager and chief waterworks engineer. Preparation of plans and specifications and supervision of construction was handled by the writer. Acknowledgment is due Mr George Van Dorp, superintendent of the plant, for cooperation in switching from old to new equipment, and to J A Young Co, for successful completion of the installation.

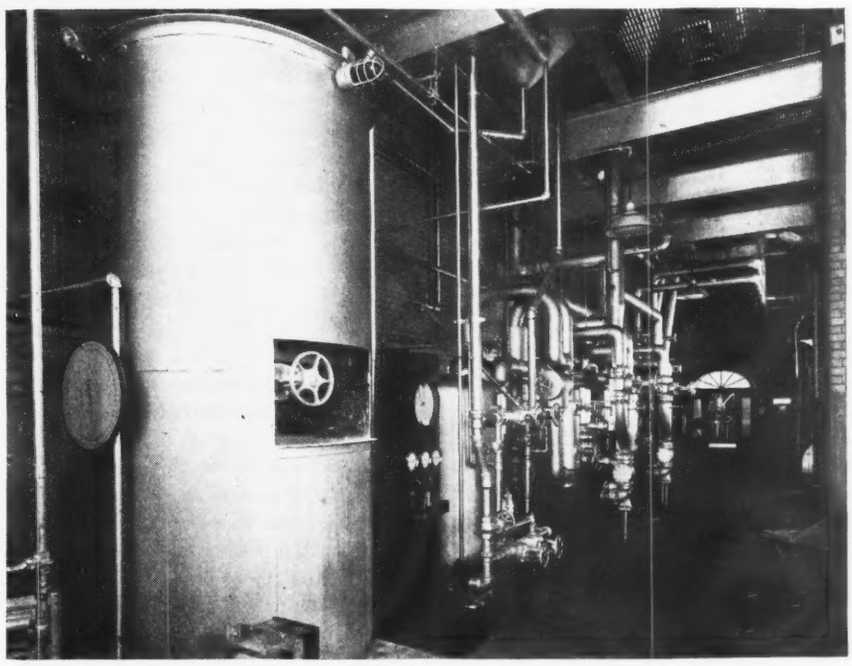


Fig. 5—New pump room in building extension also houses water-softening equipment

# Common Sense in Industrial Power

***R A Langworthy, consulting engineer, explains some practical pointers drawn from long experience in industrial power***

▶ THE SUPPLY OF POWER to industry is not a simple problem. Taken by and large it is the most complicated problem in the power-supply field. By no known and accepted method can it be reduced to "words of one syllable". Industrial plants differ widely. Their design depends on often complicated relations between steam and electric loads; refuse and unusual fuels are frequently utilized, and the plant usually must fit into an exacting production picture. In many years spent in analyzing conditions and designing plants for industrial use, I have never seen two of them exactly alike.

Such plants must be "tailor made" to meet the requirements of each specific case, and the analysis of the facts must be refined to the last degree in some instances to arrive at the correct answer.

I shall not attempt any detailed analysis of the various factors entering into the cost of industrial power, for it would serve no useful purpose. Neither shall I present any specific figures from individual cases. Such figures would not apply to a different situation, and any attempt to use them in whole or in part might be misleading. However, some general comments presented without technicalities may prove helpful to managers and executives facing industrial power problems.

### *Three Factors*

When the management and the engineer contemplate a new power supply or the revision of an existing supply, they usually face three broad alternatives:

1. Generation of the entire steam and electric load

2. Generation of steam and purchase of electric power

3. Some combination of 1 and 2

Here lies one of the most important choices and the one most difficult to generalize. Obviously, the first plan will produce power at low cost if there is any appreciable demand for process steam. The attractiveness of the second plan depends on the utility rates available, particularly in respect to demand charges, peak penalties, etc. In many cases, simple arithmetic will indicate the broad plan to follow; others require careful analysis. Combination schemes like (3) provide the best answer in many borderline cases.

In any plant program, brand-new or modernization, remember that simplicity is the earmark of competent, sensible engineering practice. After all, the plant is built to provide economical and reliable power with a minimum of investment and not as a laboratory experiment. Avoid the temptation to "ape" the large central station—don't hang "gadgets" on a small plant until it looks like an overgrown Xmas tree.

Remember that central stations use high pressure for definite reasons related to their particular cycle of operation. The choice of pressure for an industrial plant depends on an entirely different kind of reasoning. In most cases, the relation between steam and power loads dictates the range of pressure within fairly close limits. This again requires an analysis of conditions in the particular plant involved. The point to be made here is simply this: don't assume that high pressure and high efficiency necessarily go hand in hand; don't feel that low-pressure operation is "old-fashioned". In general, use of high pressure increases first cost, complicates design, and requires better operation and maintenance. High pressure, for any plant, must offer definite gains to overcome these drawbacks.

Today, automatic devices can be bought to control almost anything except one's temper. In the small plant, however, they should be applied with moderation and a true understanding of their functions and advantages. It isn't such a bad idea to leave something for the operator to do.

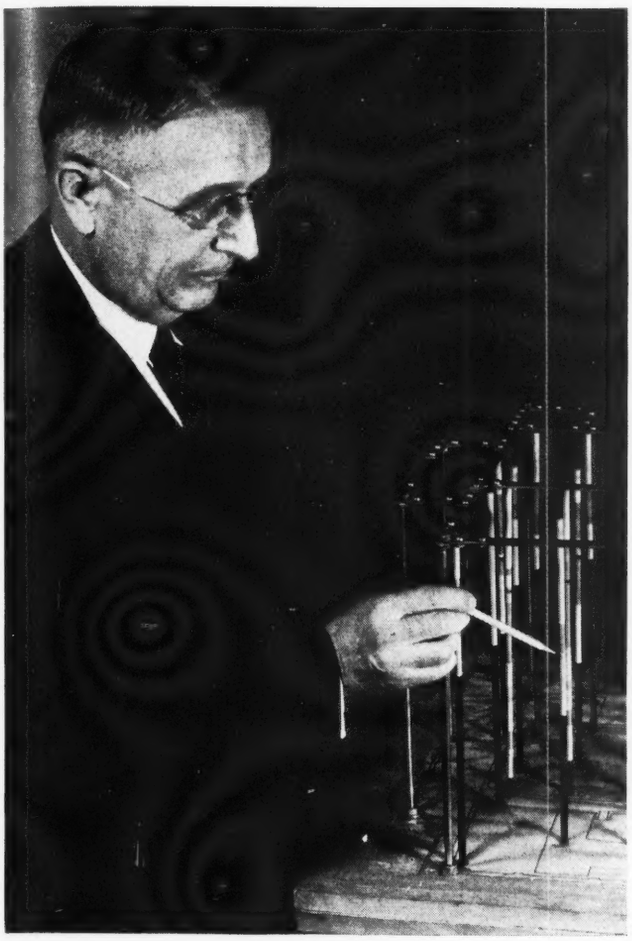
It seems obvious that the time to think about fuel is before the plant is built or modernized, but many plants are paying through the nose today for lack of just this "fuel foresight". Remember that any firing system, and any boiler furnace, gives best results, normally, on the fuels for which it was designed. It's the engineer's job to see that the equipment is designed for the fuel or fuels most likely to cost least over a period of years in a given locality. Don't overlook cheap local fuels because they aren't as easy to handle; this applies particularly to refuse fuels of various kinds. Many industrials find real profits in waste piles at the cost of a little ingenuity in working out methods of firing.

In most cases, spending only a little more in the original installation will fit a plant to handle varying grades of a single fuel, or more than one fuel. Such an arrangement protects against unpredictable changes in the fuel situation and gives added bargaining power and freedom in fuel purchasing. This is particularly important in areas where coal and oil are competitive.

### *Adequate Furnaces*

Install enough boiler capacity so that normal loads may be carried at moderate ratings. This will mean better efficiency, greater reliability and less maintenance. It is equally important to provide ample furnace volume for the boilers. Any engineer with wide experience in industrial power work will agree that lack of furnace volume limits output in more plants than any other single cause. It is usually possible to step up the heat-absorbing capacity of a boiler—the high output per sq ft of surface in modern boilers proves this—but in the average case, increases in heat release, per cu ft of furnace, can't be had without smoke and poor combustion, as well as increased furnace maintenance. It's usually cheaper to be generous with furnace volume at the beginning and be safe, than to skimp on volume and be sorry.

Since the days of James Watt, countless boiler designs have appeared—many fell by the wayside, but enough survive to indicate that no one type offers a solution to all problems, none can fit all plants and loads. This is a good place to say a few kind words for the hrt boiler, regarded by many as a relic of the past. Regarded without



**R A Langworthy comes by his power opinions by virtue of a quarter century of experience. It's an imposing 25 years, as the record shows. From 1909 through 1911, he was designer and draftsman, then construction supt, for Ford, Bacon & Davis. After three years with Meikleham & Dinsmore, first in charge of construction work and later as manager of an operating power network, he was successively chief engineer of American Engrg Co and of Federal Power & Light Co, Boston, and mechanical engineer for Stone & Webster. After eight years with Dwight P Robinson & Co, Mr Langworthy served two years as general manager of Ruths Accumulator Co. From 1928 through June, 1935, he was manager of the New York District Office of United Engineers & Constructors, Inc. Since then, he has directed his own organization. The photo shows Mr Langworthy examining his model of core drillings for the foundation of an institutional power plant in Pennsylvania.**

prejudice, the hrt offers simplicity, low first cost, and large steam-storage capacity to meet sudden demands—all qualities desired in industrial power plants. In recent years, boiler manufacturers have developed water-tube designs featuring simplicity and ease of installation combined with modern innovations such as water-cooled furnaces. Applying lessons of big boiler design in this manner produces units that offer many advantages for industrial plant use.

A small additional outlay for water treatment and adequate metering facilities protects the boiler-plant investment. Keeping boiler feedwater in condition is a lot like keeping yourself in condition. It pays to get a diagnosis from a reliable physician (feedwater specialist); the cost of medicine (treatment chemicals) need not be excessive. Adequate metering simply gives the operator a chance to get all the efficiency out of equipment that is so painstakingly built into it. Skimping at this point is a true case of "penny wise, pound foolish".

To some extent, the choice of prime mover is decided when the private power vs purchased power vs "combination" problem is thrashed out, since any relative economy figures will necessarily be based on actual rather than hypothetical equipment. This is the same as saying that prime mover selection depends on relation between steam and power loads, which it obviously does, particularly when the choice is the broad one between steam and diesel.

The modern diesel is a fully developed and perfectly reliable source of power. It operates at higher efficiency than any other prime mover and this efficiency is not materially affected by the size of the unit or by operation at partial loads. On the other hand, diesels usually operate on fuel that is more costly than that required for boilers. By waste-heat recovery, diesels can be made to handle small process-heat loads but where large quantities of heat are needed, boilers must be provided, and under these conditions byproduct power generation with turbines or steam engines usually proves cheaper. Thus the diesel fits best in plants with small heating and process-steam load.

If conditions indicate a steam plant, choice must still be made between engines and turbines. Steam engines are highly reliable and run year in and year out with little attention. Steam consumption of engines runs lower than that of small turbines, which may or may not be an advantage, depending on the steam and electrical loads. Engines usually operate non-condensing, supplying low-pressure steam to building heating or process.

The extraction steam turbine offers extreme flexibility in meeting process-steam demands and can be built for any condition within reason. It is particularly useful when steam must be supplied to process at a fairly high pressure or at several pressures.

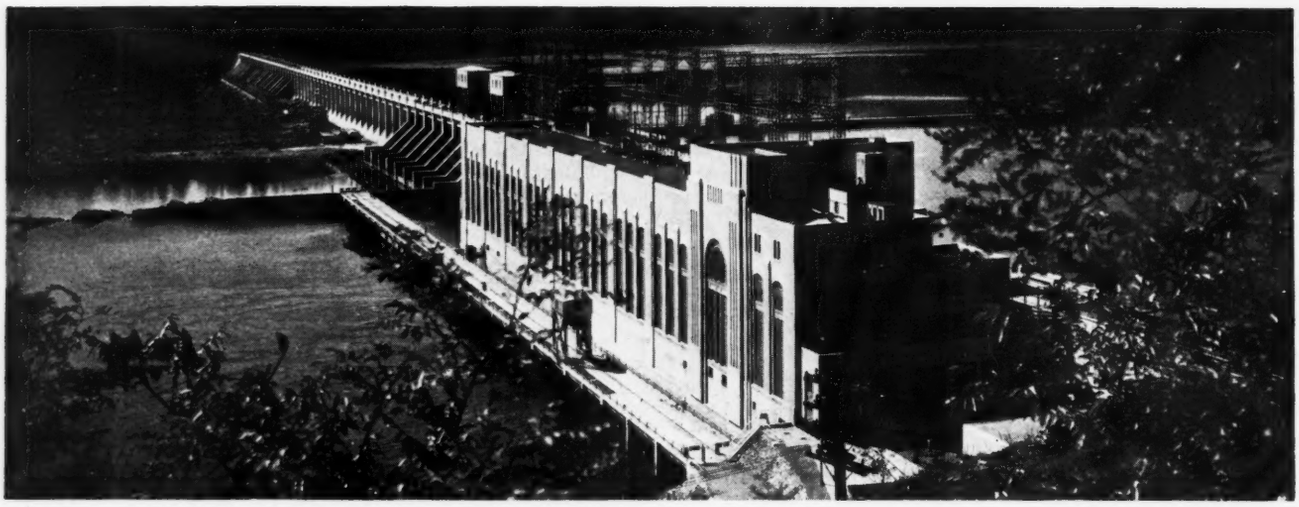
### *The Electrical System*

All too often, the electrical system is the stepchild of the industrial power plant; conditions range from deplorable to dangerous. Don't forget that a real switchboard or feeder failure may cause more harm than a failure in the generating equipment, where spares are usually available. A major electrical failure would shutdown the average industrial plant, with serious loss of production time.

Many electrical systems grow over a period of years in a haphazard fashion, because no one takes the time to look ahead and provide for expansion in a logical manner. So we find circuits tied to already overloaded switches, jumpers added to relieve overloaded conditions, with no thought of circuit segregation in case of trouble. In other plants, operators and production men are handicapped by use of different types of current and different voltages.

In a new plant, the cure is cheap—it only means making a plan for the growth of the electrical system and then sticking to it. For an existing system the only satisfactory procedure involves making a complete survey of the actual set-up and determining a plan for consistent future development. Enough money should be spent at the beginning to start this plan on a sound basis, and all future work should conform to the plan. The expense may be spread over several years if necessary, but if the plan is followed, the ultimate system will meet plant needs satisfactorily.

The two main factors in any industrial-power-supply problem are reliability and cost. Remember that a shutdown in the power plant, while costly in itself, usually causes a still more costly loss of production. This fact is often overlooked by executives who consider the power plant as a necessary evil rather than as a vital *production* department. Remember also that the only cost which has any meaning is the total in dollars per year. This is the real yardstick for any proposed change or addition.



Safe Harbor plant has six 42,500-hp Kaplan turbines in service and a seventh unit being installed for operation under 55-ft head

# Safe Harbor Hydro Plant Meters Water Flow—I

***How an extremely accurate metering system was developed, after several years' study, for continuous measurement of the water flow to each of seven main and two service turbines. A second article will describe the metering equipment and results obtained***

By J M MOUSSON
*Hydraulic Engineer*
*Safe Harbor Water Power Corp*

▶ AUTOMATIC CONTINUOUS MEASUREMENT of waterwheel discharge is not new. However, several recent improvements in this type of metering equipment have entirely changed the economic possibilities of its use. Many of the shortcomings of earlier installations, limiting its usefulness, have been overcome.

Equipment of this kind was contemplated at Safe Harbor plant, about 25 miles below Columbia, Pa., on the Susquehanna River, at the beginning of its construction in 1930, and provisions were made in the substructure, on the generator room floor, the conduit system, and the control room. However, time required for necessary research work to develop suitable water-measuring equipment delayed its installation until late in 1938.

Our investigations dealt with the principle to be employed in making the measurements and the possible consistency, sensitivity and suitability of various metering apparatus. First, it had to be established that the index method, based on differential piezometer deflection, is sufficiently accurate to be used as a basis of continuous water measurements.

### *Piezometer Investigation*

In each of the substructures of the six main units comprising the initial development, there were installed three piezometers of the Winter-Kennedy type in the turbine scroll, as in Fig. 1, and two piezometers of the Peck type on one of the stay vanes of the speed ring, Fig. 2. While one of the Winter-Kennedy taps was placed in the high-pressure low-velocity region, at the outer periphery of the scroll case, the two other taps were located radially opposite it at the speed ring in the low-pressure high-velocity region. One of these is just above the speed ring and the other tapped in the crown of the speed ring.

The impact tap for the Peck piezometer is in the nose and the low-pressure tap in the flank of one stay vane. In the first four main units installed, the impact tap was placed at the nose tip, Fig. 2*A*. On the fifth main unit the impact tap was placed at a slight angle to the longitudinal axis of the stay vane, ¾ in. from the nose tip, Fig. 2*B*, and on the sixth unit it was placed 45 deg, or 2⅛ in. from the centerline of the stay-vane nose, Fig. 2*C*. The low-pressure tap on the latter two units was also shifted toward the nose of the stay vanes as indicated in Figs. 2*B* and *C*.

In addition, two auxiliary piezometer openings were incorporated in the downstream nose of one of the intake piers of each main unit for possible use should the units ever be operated as pumps for peak water storage during low flow. Both service units have two Winter-Kennedy piezometers. To prevent air pockets, all piping (copper for corrosion resistance) leading to the individual piezometer openings has a continuous slope. In the pipe tunnel beneath the generator-room floor we installed a piezometer board with vertical glass tubes at each unit, where the deflection could be measured in feet of water.

After each unit went into service we

first determined which combination of two piezometers would give the most consistent indications. This was done by plotting the differential pressure of any two taps against that of any one of the other possible pairs. Fig. 3 shows that the three Winter-Kennedy taps and the Peck impact tap $Y_1$ gave markedly more consistent readings than the Peck low-pressure tap $Y_2$. The latter was responsible for the erratic behavior in three of the plots. On the other five main units, the results were similar with the exception that even the Peck impact tap located closer to the nose or at the nose of the stay vane was considerably less steady. For all main units, the Winter-Kennedy taps showed a high degree of consistency.

These results should not be interpreted as a general weakness of the Peck system. After investigating the origin of the erratic behavior of these taps, we found that the cause, particularly of the low-pressure one, was in the design of the stay vanes rather than in the piezometer system.

### *Piezometer Calibration*

Initially, the piezometers were used as a relative index to determine the proper relation between turbine-blade and guide-vane positions under various operating heads, this in turn to serve as a basis for the cam designs controlling the gate-blade relation. These piezometers were, however, calibrated for absolute discharge measurements in course of the acceptance tests on the units, made by the two-type-current-meter method. The results obtained for the piezometer pair $R_4-R_2$, Fig. 1, of the Winter-Kennedy system of two main units, are shown on Fig. 4.

Of the six main units, three were tested by current meters. The piezometers of the others were calibrated indirectly by assuming their peak efficiencies to be identical to that of the units of same design and manufacture that were tested. This procedure was also followed for the two identical Francis-type service units. We tested one of them by current meters and assumed the peak efficiencies of both to be alike.

This procedure is not absolutely correct because identical units do not necessarily have identical peak efficiencies. However, based on experience available, it is believed that the error will not exceed 1% for any one unit and that the average for the whole station should be even closer. To guard against unexpected future trouble which would render one or the other piezometer unreliable or useless, all taps were calibrated during these tests. These calibrations showed that the accuracy of the systems are fully adequate as a basis for continuous-flow measurements.

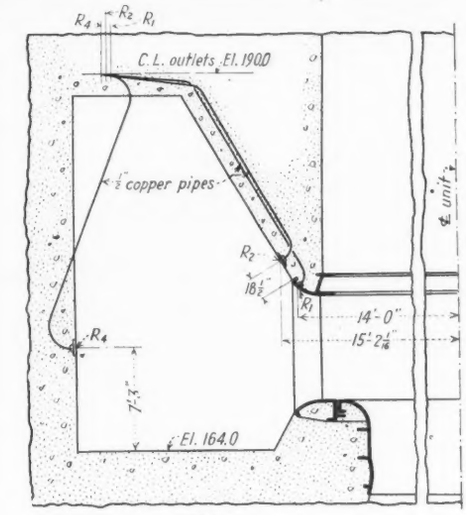



FIG. 1

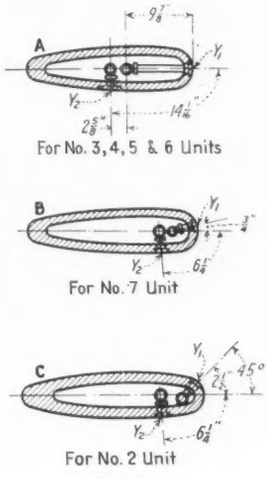



FIG. 2

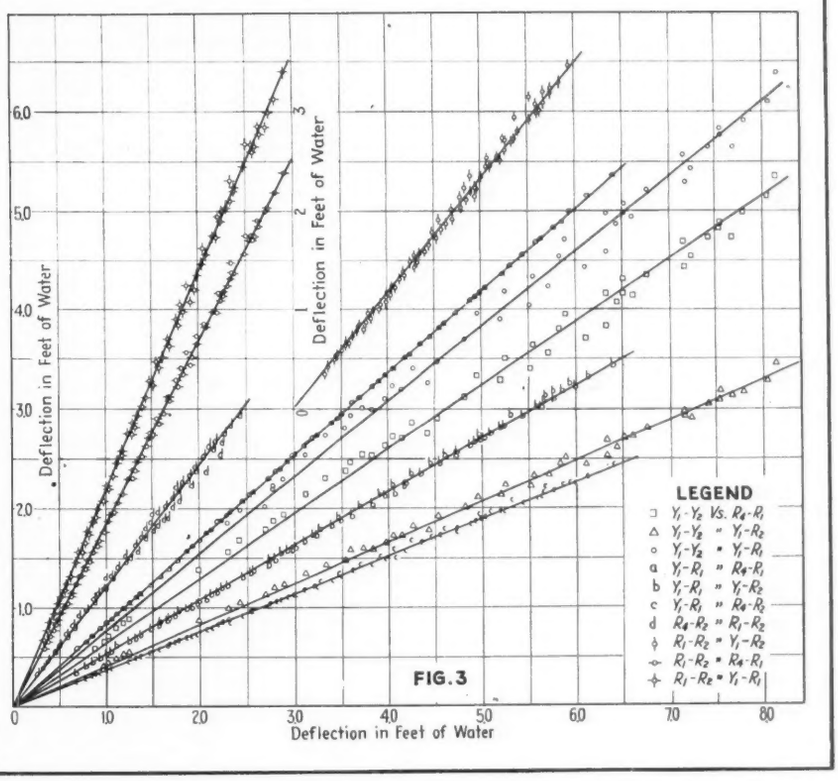



FIG. 3

**Fig. 1—Location of Winter-Kennedy piezometer connections, $R_1$, $R_2$ and $R_4$, on the main-unit scroll cases. Fig. 2—Location of Peck piezometer connections, $Y_1$ and $Y_2$, on the main unit scroll-case stay vanes. Fig. 3—Analysis of piezometer deflection obtained on No. 2 main unit by plotting the differential pressures from two pairs of taps**

As a next step, we made annual tests to see if the piezometers would keep their calibrations over a period of years. These tests made in 1932, '33 and '34 indicated that, during the period of observation, no change in calibration took place. These tests also demonstrated that the piezometers are sensitive to factors that may affect turbine efficiency and are therefore useful to detect improper operating conditions.

During 1934 and 1935 three types of flowmeters, each employing a different principle, were investigated in detail to see which type would meet the rigid requirements or could be further developed to a satisfactory stage. Aside from a minimum amount of maintenance desired, the chief requirements were: a high degree of accuracy and sensitivity over the useful range, the possibility of totalizing the unit flow automatically for the entire station, as

well as metering characteristics permitting short duration tests on each unit to determine its efficiency.

### *Flowmeter Selected*

Fig. 5 is a diagram of the type of flowmeter selected. The essential parts of this instrument are a tilting mercury manometer and a motor-integrator carrying a flyball system so arranged that the centrifugal force due to rotation of the flyballs is opposed to the force of the tilting manometer. A magnetic switch operated by the tilting-manometer beam controls the motor speed, maintaining a balance between the centrifugal force of the motor-integrator and the piezometer differential force acting upon the tilting manometer. Since the force due to the piezometer differential varies with the square of the flow being measured and the centrifugal force of the integrator also varies with the square of the integrator speed, the two square laws cancel, thus leaving a direct relation between flow and integrator speed. A counter geared to the motor integrator shows revolutions in terms of flow.

An experimental flowmeter of this type was installed temporarily on one unit. Short-duration efficiency tests on this meter showed a very small spread of test points and a very good agreement with the results of the turbine acceptance tests. The execution of these tests was simplified considerably by recording the flowmeter-counter-shaft revolutions, by electrical impulses, on a recorder chart simultaneously with the revolutions of the watthour-meter disk and with second impulses. The watthour-meter disk revolutions were obtained through a photoelectric-cell arrangement—a small electric bulb on one side of the disk and the photoelectric cell on the opposite side. The beam of light causing the impulses fell through the balancing hole in the watthour-meter disk. The second impulses were also obtained by a photoelectric-cell arrangement mounted on the master clock for frequency control of the system, the pendulum cutting the light beam.

Next, the flowmeter errors were analyzed by standard water-column tests. The error curve had the typical shape of a rotational integrating device. While the test points were rather consistent, it was, nevertheless, concluded that further improvement of the meter should be carried out to flatten and lengthen the horizontal leg of the error curve and improve its accuracy to such a degree that even analytical-compensating measures would not be required for short-duration efficiency measurements on the turbines. This was done by the meter manufacturer; the check calibration curves of three flowmeters after installation, are shown in Fig. 6. How the meters were installed on all units in the Safe Harbor plant and the benefits obtained from their installation will be described fully in the November issue of POWER.

**Fig. 4—Calibration of piezometer pair ($R_4$—$R_2$) on Nos. 4 and 5 main units by two type-current-meter method. Fig. 5—Diagram of the type of flowmeter selected for integrating water flow (courtesy Leeds & Northrup Co.). Fig. 6—Check calibration curves of three flowmeters after installation**

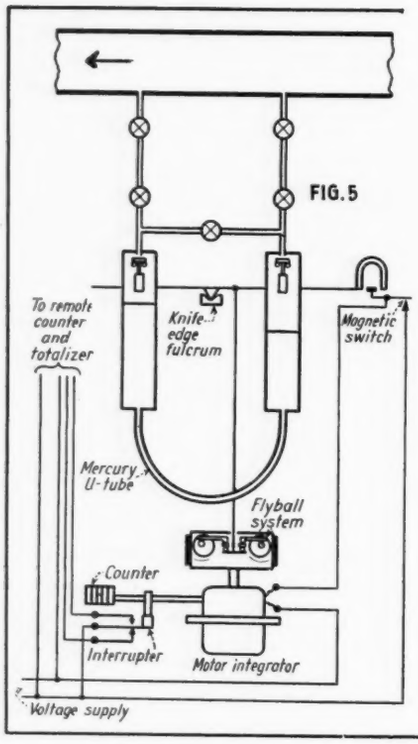


FIG. 5

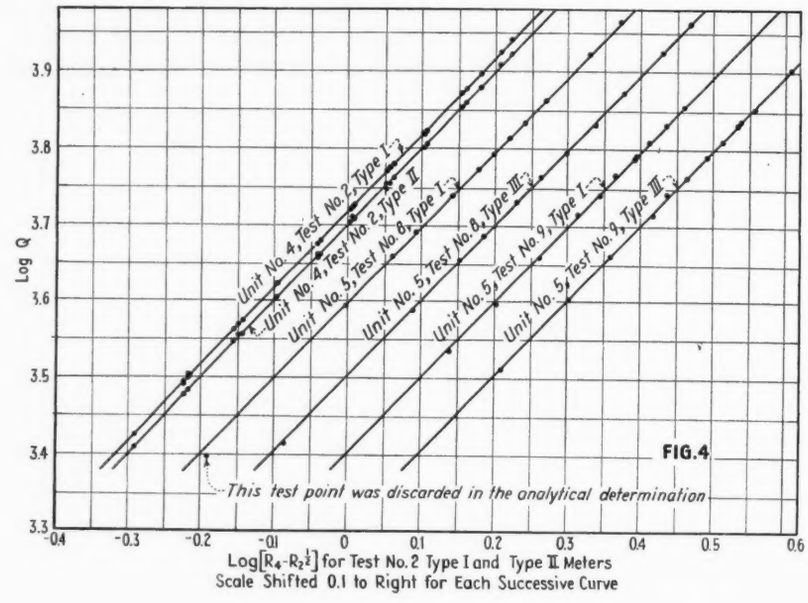


FIG. 4

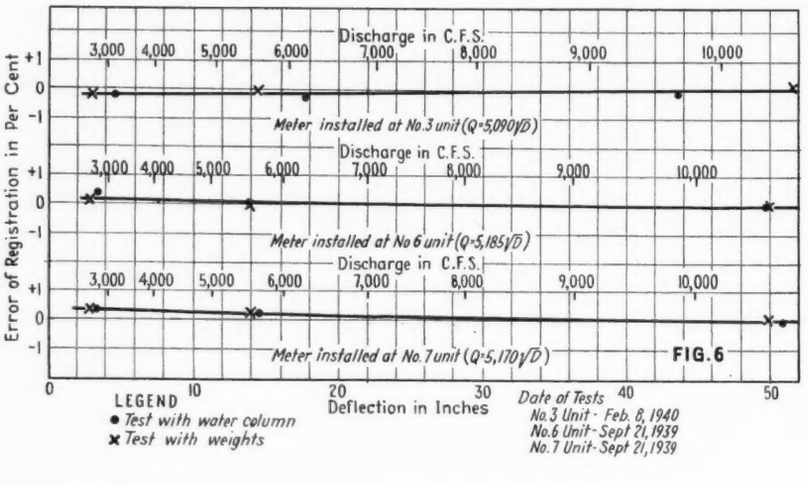
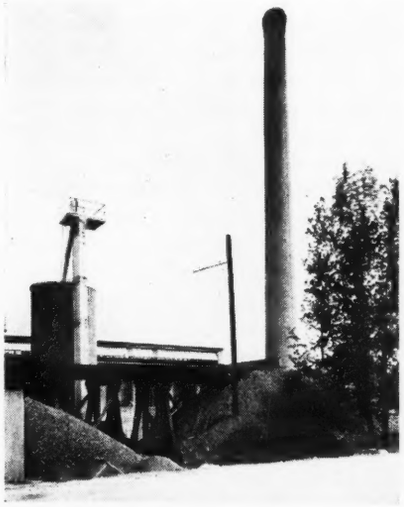


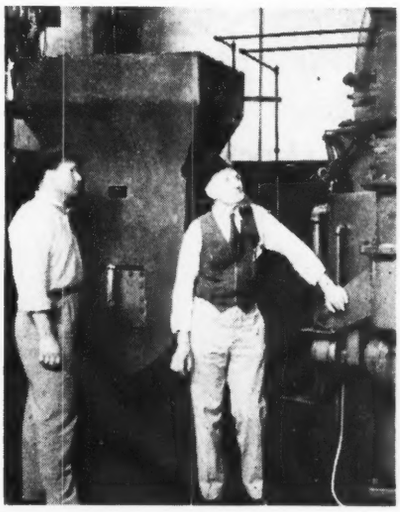
FIG. 6

# 5520 Tons of Coal per Year Saved

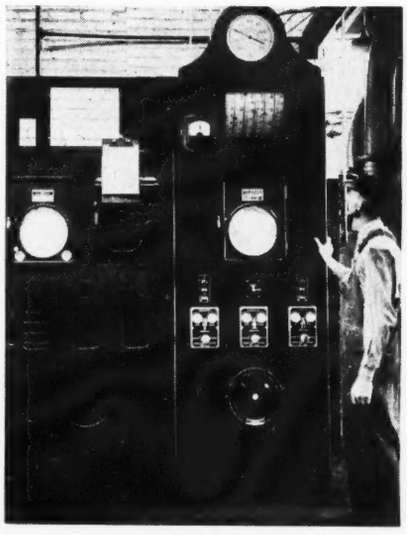
***Modernization at Southern Bleachery and Print Works will pay out in a little over three years***



Bucket elevator carries coal from track hopper to silo mounted on roof of pulverized building. New boiler, fired by two pulverized-coal burners, delivers steam at 215 lb, 540 F



L S Misenheimer (left) and L W Misenheimer survey the new ball mill. At left background is preheater for air supplied to the mill



Right-hand board carries hand-operated controls for new boiler. When second unit is added, left-hand board will be fitted out and both boilers placed on full automatic control

► MODERNIZED IN 1937, with a new pulverized-coal-fired boiler and associated equipment, Southern Bleachery and Print Works, Greenville, S.C., is now saving 5520 tons of coal yearly (100 car loads) valued at $25,547. The saving is 30.5% on the investment.

This typical Carolina textile plant had been served by six 2500-sq-ft hrt boilers generating steam at 160 lb. Process steam was bled at 40 lb g from a 750-kw condensing turbine. In 1937 two of the old boilers were sold to make room for a Babcock & Wilcox Integral-Furnace unit rated 70,000 lb per hr continuous maximum when generating steam at 375 lb and 725 F. This boiler, now operating at 215 lb and 540 F, is equipped with superheater and a steel-tube economizer.

The fuel, a medium-volatile Virginia coal, is carried from storage yard or track hopper by belt conveyor and elevator to a 120-ton tile silo mounted on a concrete slab. This slab is in turn supported by the steel roof of the pulverizer room. From the silo, coal flows by gravity through automatic weighing scales to a single ball mill. Fuel is fed through two horizontal burners.

### *Old Equipment Still Used*

At present, four of the six original hrt boilers remain as standby. Eventually two more will be removed to make room for a second modern steam-generating unit. The original turbine is still operating, taking steam at 155 lb g and extracting to process at 40 lb. Very little steam goes to condenser. Power demand, beyond that generated by this turbine largely as a byproduct, is purchased from Duke Power Co.

Modernization work was supervised by J E Sirrine & Co, consulting engineers, Greenville. Boiler and pulverizer were installed by Babcock & Wilcox Co, the piping by Poe Piping & Heating Co, Greenville. Most of the other construction was done by the plant force under L W Misenheimer, master mechanic, and his son, L S Misenheimer, engineer in charge of the steam plant.

Following is the 1939 "steam report":

| | |
|---|---|
| Steam generated in all boilers, lb | 386,187,100 |
| Total coal used in all boilers, lb | 36,802,540 |
| Lb steam generated per lb coal | 10.48 |
| Total Kiers boiled | 4836 |
| Lb coal per Kier | 7625 |
| Heat regained in economizer in lb coal | 1,946,364 |
| Heat regained from Mill return in lb coal | 2,432,955 |
| Lb steam used per yd of cloth | 2.532 |
| Lb coal used per yd of cloth | 0.2443 |

## PRINCIPAL NEW POWER EQUIPMENT

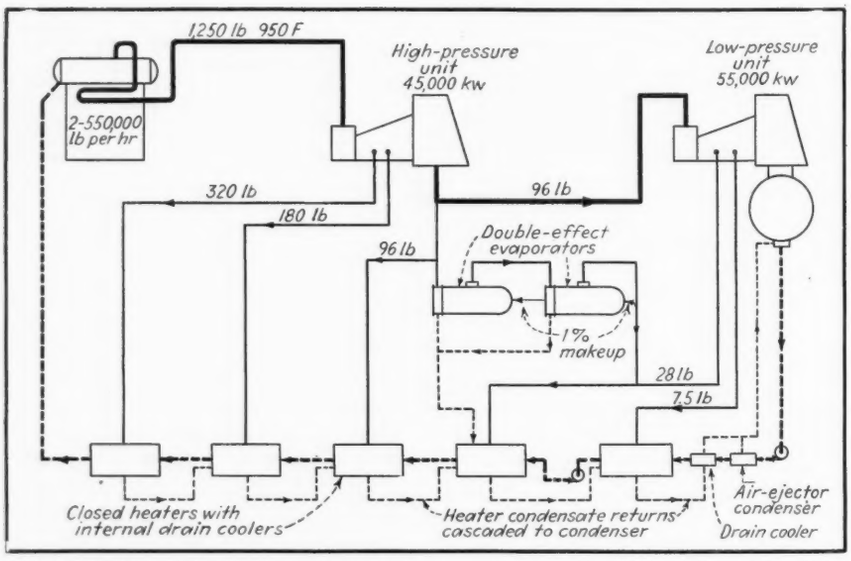
### *Modernization of Southern Bleachery & Print Works, Greenville, S. C.*

| | |
|---|---|
| Integral-Furnace boiler, superheater, economizer. Maximum continuous rating 70,000 lb per hr under ultimate operating conditions of 375 lb and 725 F. | Babcock & Wilcox Co |
| Pulverized-coal burners, two (one low range) | Babcock & Wilcox Co |
| Pulverizer, one, Type B | Babcock & Wilcox Co |
| Preheater for pulverizer air | Aerofin Corp |
| Coal-handling equipment (track hopper, conveyor, elevator) | Jeffrey Mfg Co |
| Coal scales, automatic | Richardson Scale Co |
| Forced-draft fan, motor-driven | B F Sturtevant Co |
| Induced-draft fan, turbine-driven | B F Sturtevant Co |
| Induced-draft-fan-drive turbine | Elliott Co |
| Multi-stage centrifugal feed pumps, two | Ingersoll-Rand Co |
| Deaerating heater, 120,000 lb per hr capacity | Elliott Co |
| Continuous-blowdown flash tank and heat exchanger | Cochrane Corp |
| Zeolite water softener | Roberts Filter Co |
| Multi-pointer draft gages and boiler meter | Bailey Meter Co |
| Soot blowers | Diamond Power Specialty Co |
| Feedwater regulator | Bailey Meter Co |
| Inclined water gage and column | Yarnall-Waring Co |
| Blowdown valve, Yarway | Yarnall-Waring Co |
| Sootblowing and superheater-header drains | Edward Valve & Mfg Co |
| Feedwater valves | Lunkenheimer Co |

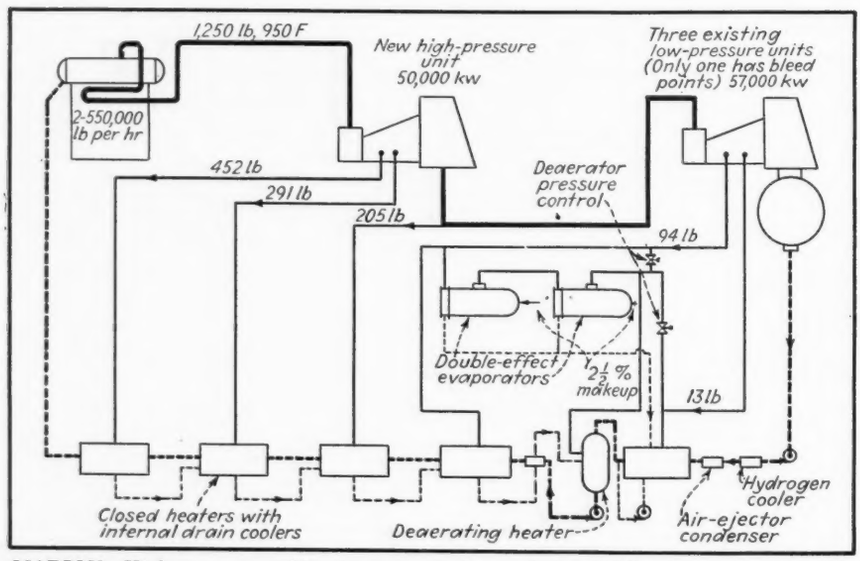
# How Ten Utilities Hook Up New Units

***Central-station heat balances are as individual as ever; designers still arrange equipment to get the best tailor-made operating cycle for local special conditions. These new installations present some new ideas in interesting variety***

By S A TUCKER
*Associate Editor*




**BURLINGTON—High-pressure base-load cross-compound turbine unit drives two identical 3600-rpm generators totalling 100,000 kw**




**MARION—High-pressure turbine is superposed on existing 200-lb plant with provision for future new low-pressure condensing machine**

► STANDARDIZED HEAT-BALANCE ARRANGEMENT hardly describes central stations of 1941. None of the installations here shown has yet gone into regular operation (although one is practically a duplicate of an operating unit); they thus represent design ideas of relatively recent date.

Features of this group are: (1) a turbine with two sets of first-row stages, one to supply extraction steam for process, (2) a topping unit designed for later revamping of the condensing turbines, (3) a turbine that extracts at four points to supply a district heating system, (4) a logical but novel cross-compounding arrangement, (5) several instances where least first cost and simplicity were guiding principles.

Flow diagrams of the several plants have been greatly simplified and reduced to a more or less standard schematic arrangement for comparison purposes. A brief explanation of the functioning of each plant follows:

***Burlington*** station of the Public Service Electric & Gas Co of New Jersey will have a 100,000-kw cross-compound unit for 1250-lb, 950-F initial steam conditions, ready for operation late in 1940. A feature is the use of duplicate 3600-rpm, 50,000-kw, hydrogen-cooled generators with the high and low-pressure elements of the machine. The low-pressure element consists of two double-flow turbines coupled together.

Five stages of feed heating use steam extracted from two points in the high-pressure element, one at the crossover, and two points in the low-pressure turbine elements. Feedheaters are all closed with condensate cascaded through drain coolers to the condenser. Deaeration is accomplished in the condenser hotwell; no deaerating heater is employed.

Boiler-feed pumping will be done in two steps; primary pumps with hydraulic-coupling speed control supply constant-speed secondary pumps to maintain a constant differential across the feedwater-regulating valve.

***Marion*** station, also of Public Service Electric & Gas Co, will operate a unit in the summer of 1941 quite similar to the high-pressure element of the Burlington installation. Laid out as the first step of a 100,000-kw condensing installation, the two boilers and high-pressure turbine will operate as a superposed unit in conjunction with the present 200-lb turbine plant.

Feedwater-heating cycle and equipment were selected to suit superposed operation. An open heater is used for deaeration. When a new condensing

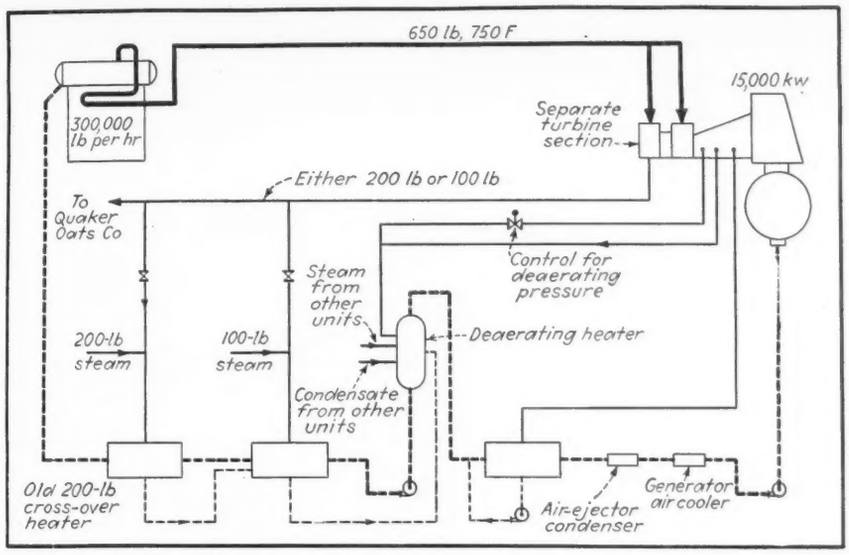
turbine is installed later, the deaerator can be bypassed without affecting the heat balance.

***Cedar Rapids*** station of the Iowa Electric Light & Power Co will place in operation late this year a 15,000-kw, 3600-rpm unit for 650-lb, 750-F steam conditions. The head end of the turbine has two sets of Curtis wheels with separate admission valves. One impulse group of nozzles and first-stage blading supplies the normal needs of the condensing turbine which extracts at three points under automatic pressure control to supply a deaerating heater and one closed heater.

The second impulse element of the machine, with its separate valve gear, can supply steam at 100-lb pressure for feedwater heating and to the Quaker Oats Co, or, alternately, can discharge to the 200-lb header of the old station as the equivalent of a superposed unit.

***Delray*** station of The Detroit Edison Co has just placed in operation (Sept, 1940) the second of three 75,000-kw, 1800-rpm units designed for 815-lb, 900-F steam conditions. Feedheating arrangement for all three will be a simple regenerative cycle employing four stages of feedheating to bring the temperature to 388 F at full load.

In addition, the 10,000-kw "experimental" unit, having served its original purpose in the study of high-temperature steam, now serves as a link between new units operating at 815-lb and three existing 50,000-kw, 400-lb, 710-F turbines. A small heat exchanger, cut into the condensate circuit of one low-pressure unit, receives gland-sealing steam from the superposed turbine; a booster boiler-feed pump returns part of the feedwater from the low-pressure system to the high-pressure boilers.




**CEDAR RAPIDS—Turbine with two head ends takes steam at 650 lb, 750 F, and supplies industrial process load, low-pressure header, feedwater heating**

***Seward*** station of the Pennsylvania Electric Co will install a 35,000-kw, 650-lb, 825-F condensing unit in an existing 250-lb plant. Boilers, already in operation, now supply steam to the low-pressure plant through a reducing and desuperheating station.

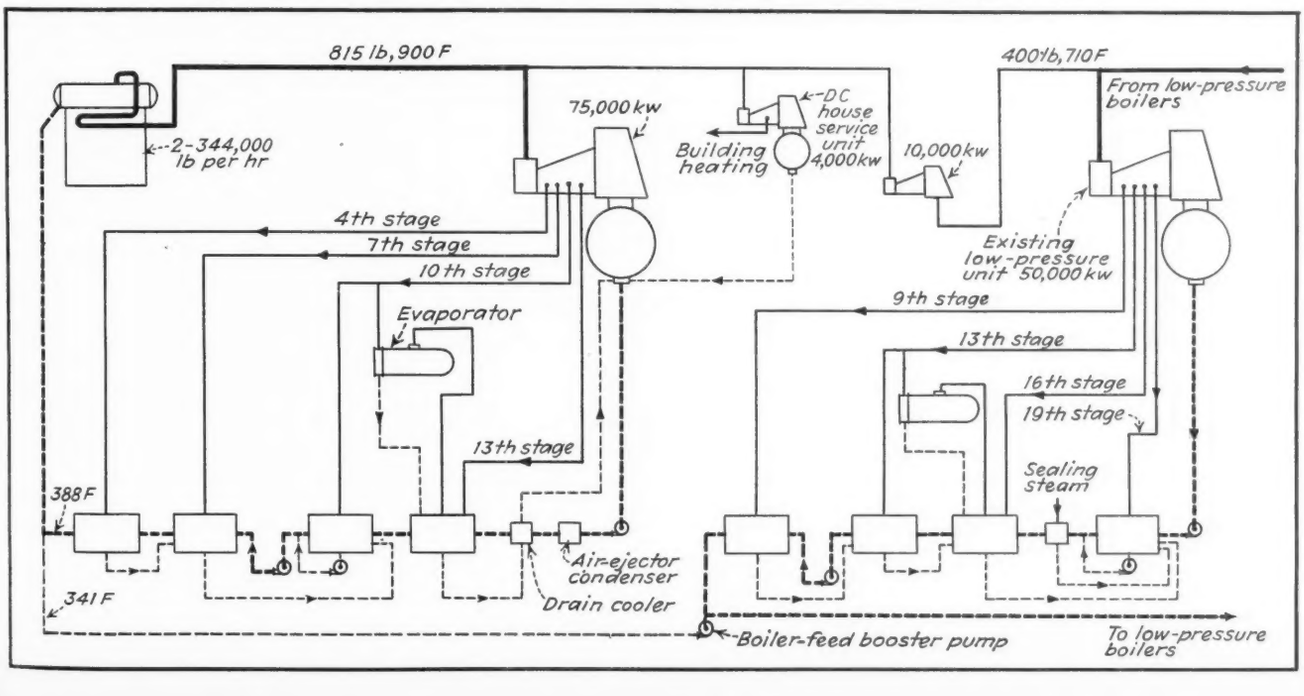
The high-pressure unit will operate independently of the low-pressure part, each feedwater system being served by a separate deaerating heater. Make-up for the high-pressure plant will be condensate from the low-pressure section. Since one of the existing turbines is served by a jet condenser, the amount of makeup introduced at the low-pressure-system deaerating heater will be about 2% plus steam requirements of the jet-condenser unit.

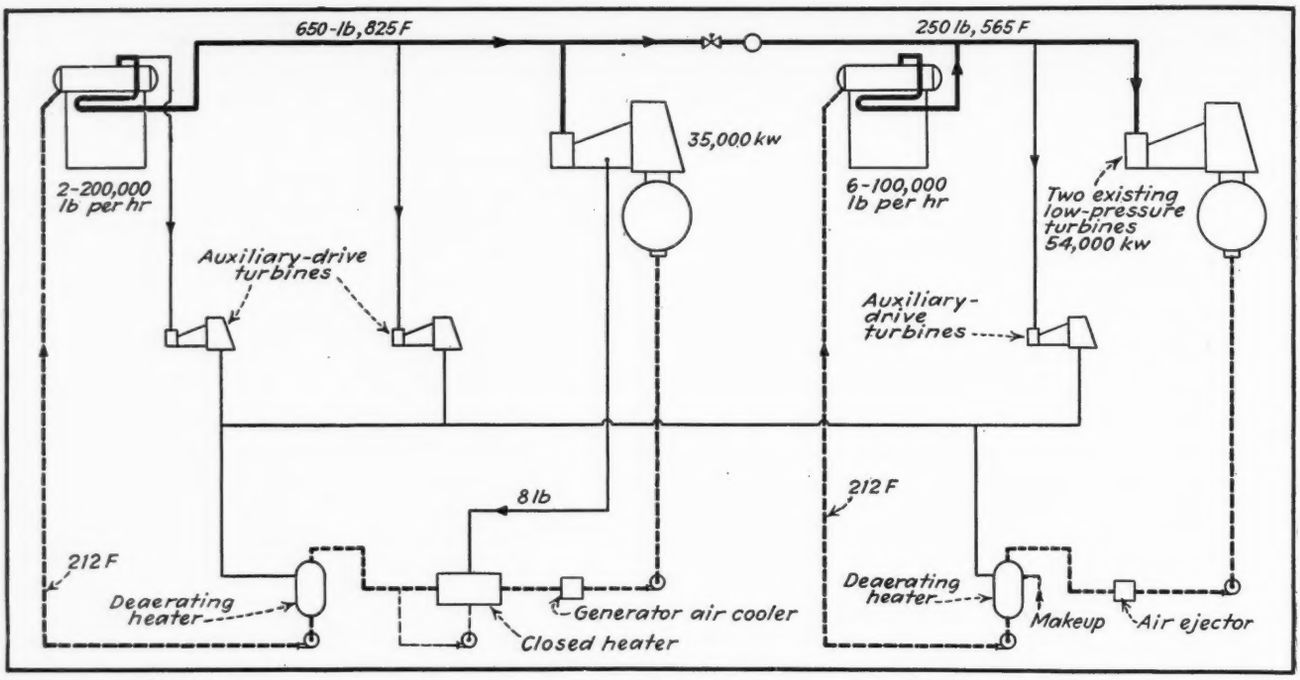
Only one stage of feedheating by bleed steam is employed, a second stage being supplied by auxiliary-drive exhaust to the deaerator. Heat balance is normally controlled by operation of steam- and electric-driven auxiliaries. For unusual operating conditions, provision for deaerator supply by hand control from one low-pressure turbine is included. A second stage heater was omitted because the gain in economy of an air preheater and smaller economizer could not be justified over a larger economizer in view of low coal cost at this mine-mouth plant.

***Commerce St*** station of Wisconsin Electric Power Co will shortly start operating a 35,000-kw, 3600-rpm condensing turbine designed for 1390-lb, 900-F steam conditions. This unit will extract a relatively large part of the throttle steam at four points for supply to the district-heating system.

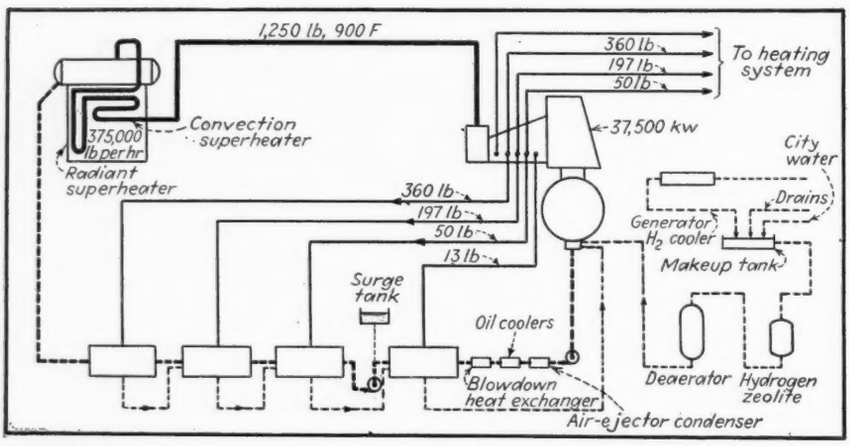
High pressure was chosen even with high (75% maximum) makeup because the gains due to extracting steam for commercial heating mount rapidly with

**DELRAY—Simple regenerative cycle characterizes main units of extension; "experimental" high-temperature turbine becomes a commercial superposed unit exhausting at 400 lb**

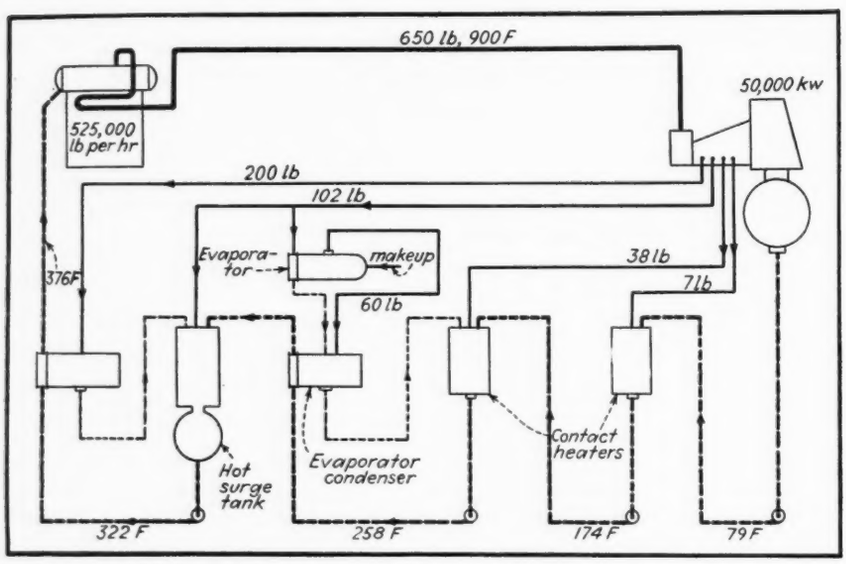





**SEWARD—New turbine taking steam from existing boilers operates separately from older low-pressure units. Single stage of feedwater heating introduces minimum complication to heat balance**




**COMMERCE ST—Four-stage extraction for district-heating steam requires high makeup. When heating demand is low, turbine runs condensing**




**BUZZARD POINT—Duplicate of previous machine operates at same steam pressure but slightly higher temperature, retains contact heaters**

throttle pressure. Large quantities of steam will be extracted for the four steam mains leaving the station and a smaller amount for feedwater heating.

Makeup will be hydrogen-zeolite-treated city water with subsequent deaeration. Equipment can be operated either in regular central-station manner or bled heavily for heating steam in cold weather. One boiler plant thus supplies both steam and electric service at an economy of investment as well as fuel use.

***Buzzard Point*** station of the Potomac Electric Co will soon place in operation (October, 1940) a 50,000-kw, 1800-rpm unit for 650-lb, 900-F steam conditions similar in many respects to existing units. The new machine conforms to the existing arrangements as far as possible to simplify operation and retain the advantages of the contact-heater cycle demonstrated by experience to be both simple to operate and economical. Studies of 900-lb and 1200-lb cycles showed an insufficient increase in economy to justify increased cost of equipment. Throttle temperature, however, was increased from the 825-F temperature of previous units at little additional cost. Oversize superheat control on the new boilers can bring operating temperature down to 825 F if it is desired to run the new boiler with one of the older turbines.

Steam is extracted at four points to three contact and one closed feedwater heaters. The closed heater has incorporated within its shell a desuperheating section so that water temperature

leaving is 3 deg F above corresponding saturated steam at heater pressure. The only turbine-driven auxiliary is a boiler-feed pump for emergency use which exhausts directly to atmosphere.

***West Reading*** station of the Metropolitan Edison Co at Reading, Pa., will top the existing 250-lb plant with a 20,000-kw turbine designed for 1250-lb 900-F steam conditions. The heat balance was dictated, to a considerable extent, by existing plant features.

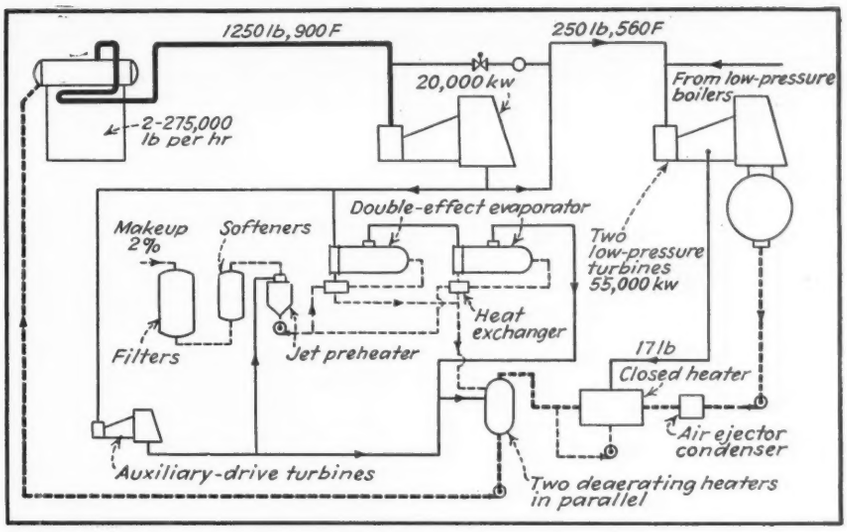
A reducing and desuperheating station will bypass the top turbine. Low-pressure turbines have a single bleed point. Two deaerating heaters operating in parallel are supplied by auxiliary exhaust. Evaporators are arranged for double-effect, single-effect and reverse double-effect operation. Evaporator output will be discharged into the auxiliary-exhaust steam header. Heat balance is normally maintained by proper sequence of operating turbine and motor-driven auxiliaries.

***Vienna*** station of the Delmarva Power Co, Vienna, Md., will place in operation in December, 1940, a 7500-kw condensing turbine designed for 650-lb, 825-F, served by a single 80,000-lb-per-hr boiler. The heat cycle of the present 350-lb plant and the expectation that the new boiler and turbine will be duplicated in the near future, dictated, to a certain extent, the heat-balance arrangement.

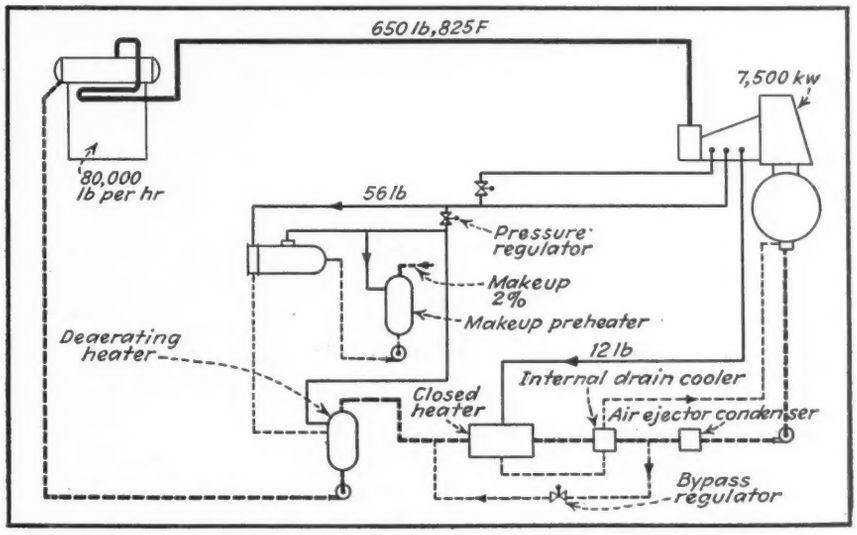
One stage heater with internal drain cooler precedes the deaerating heater. Condensate from the heater will be trapped to the condenser. Feedwater will enter the deaerating heater at 190 F at normal load; a regulating valve will bypass the heater when evaporated makeup is more than 2%. Evaporator and preheater are large enough to supply a duplicate unit to be installed later. Steam for the evaporator is extracted from either of two bleed points on the turbine depending on load.

***Alexandria*** station of the Virginia Public Service Generating Co will start up in November, 1940, a 15,000-kw, 650-lb, 825-F condensing turbine. Operation will normally be independent of the existing low-temperature units but an interconnection will be provided.

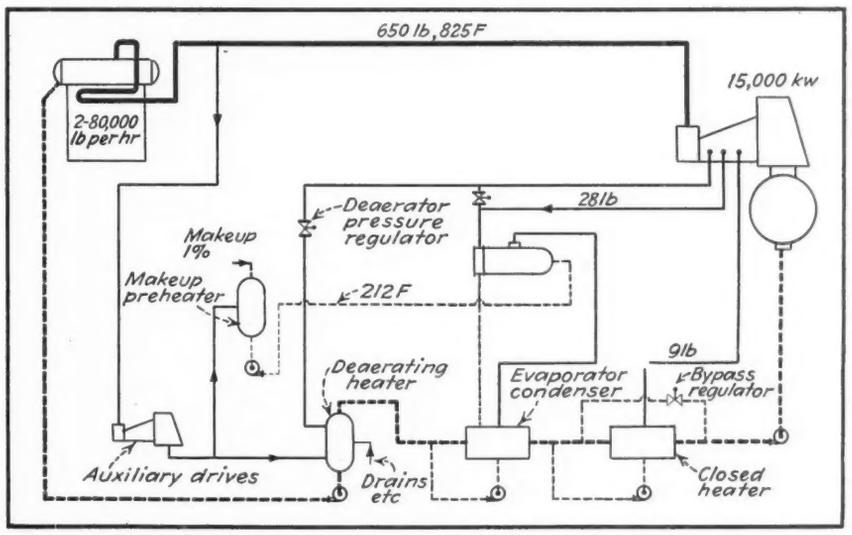
The condensate will be pumped through a single stage heater, then through an evaporator condenser to the deaerating heater. Closed-heater condensate will be pumped into the feed line beyond the heater. Makeup will be deaerated and preheated before going to the evaporator. A bypass regulator around the low-pressure heater serves to maintain a constant pressure in the deaerating heater.




**WEST READING—Existing features of low-pressure plant dictated outlines of heat balance for high-pressure superposition. Heat balance is normally maintained by proper sequence of operating turbine- and motor-driven auxiliaries**




**VIENNA—New 650-lb condensing unit in 350-lb station has only a single stage of feed heating. A second stage was omitted in favor of a large economizer because savings would not justify cost of additional heater and air preheat**




**ALEXANDRIA—New condensing unit normally operates independently of existing low-pressure station except for use of auxiliary exhaust steam**

# Stub Tubes Keep Boiler Working

***Tube failure ties up the boiler and may shut down the plant. R O Billings suggests three ways to keep going until a new tube can be delivered and installed***

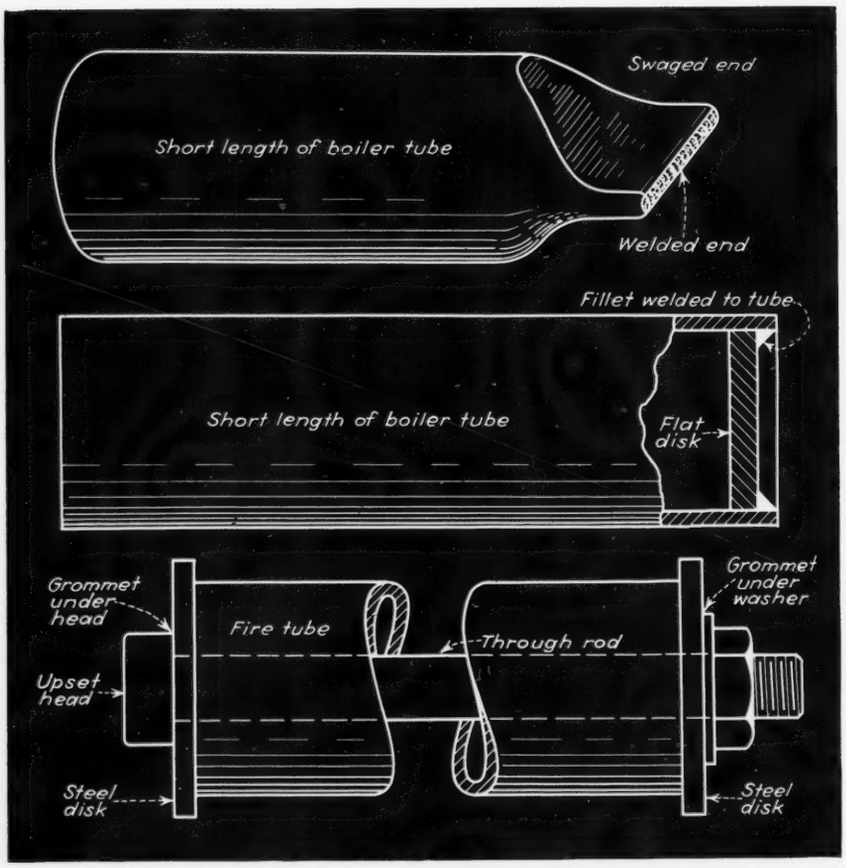



**Fig. 1 (top)—Heat end of stub tube, swage flat, scarf and weld tight. Fig. 2 (center)—Insert thick disk in end of stub tube. Use full fillet weld. Fig. 3 (bottom)—For fire-tube boilers only, defective tube may be sealed by and disks held by through bolt**

▶ TUBE FAILURE means a boiler shut-down (and perhaps a complete plant shut-down) until the engineer can get a new tube or make some temporary repair.

In the case of a straight-tube boiler a few spare tubes are generally on hand to meet such emergencies. A single bent-tube boiler, on the other hand, may use many different tube curvatures and dimensions, so that it isn't practicable to stock all spares that might be needed.

For one reason or other, it may take a week or longer to get a special tube to the job. Then it's up to the engineer to put the boiler back into service with temporary repairs.

### *Two Methods*

Figs. 1 and 2 show two ways to do it. Remove the defective tube and make sure that no other damage has occurred in the boiler. Then blank off the two tube holes with stub tubes sealed as indicated.

The stubs can be cut from the defective tube (not to include the defect) and should be long enough to allow use of the tube expander.

In Fig. 1 the end is closed by heating, swaging, and electric welding. If no welding machine or competent operator is at hand, close the end by scarfing and hammer-forging.

Fig. 2 shows a disk of fire-box grade boiler plate cut and inserted far enough within one end of the stub tube to allow a full fillet weld. Disk should be at least ½-in. thick for 250-lb pressure or less, 0.6-in. thick from 250 to 500 lb and 1-in. thick from 500 to 1400 lb. These thicknesses are for a 4-in. diameter tube, and may be reduced slightly for smaller tubes.

The open end of each stub tube is inserted and expanded into the tube hole in the customary manner.

I don't recommend such repairs where the stub end is exposed to the direct radiant heat of the fire. In any case the blank end forms a pocket for sediment, making long continued use unwise. Consider such repairs merely as a "crutch" to carry the boiler until a new tube can be installed.

Fig. 3 shows how to stop off both ends of a defective tube without removing tube. *This is for firetube boilers only.* The end disks shown are ½-in. thick and ¾-in. larger in diameter than the boiler tube. They are drilled $\frac{17}{32}$-in. to pass a ¾-in. round steel rod.

Start with a rod 4 in. longer than the boiler tube. Heat one end and "upset" it in a vise to approximately 1½-in. diameter with a clear-cut shoulder. Then anneal this head by heating to a dull red heat and cooling slowly. Thread the other end of the rod for about 2 in. and assemble as shown, with nut and washer. Place threaded end of rod at the tube end where gases leave tube so that the nuts will not burn off.

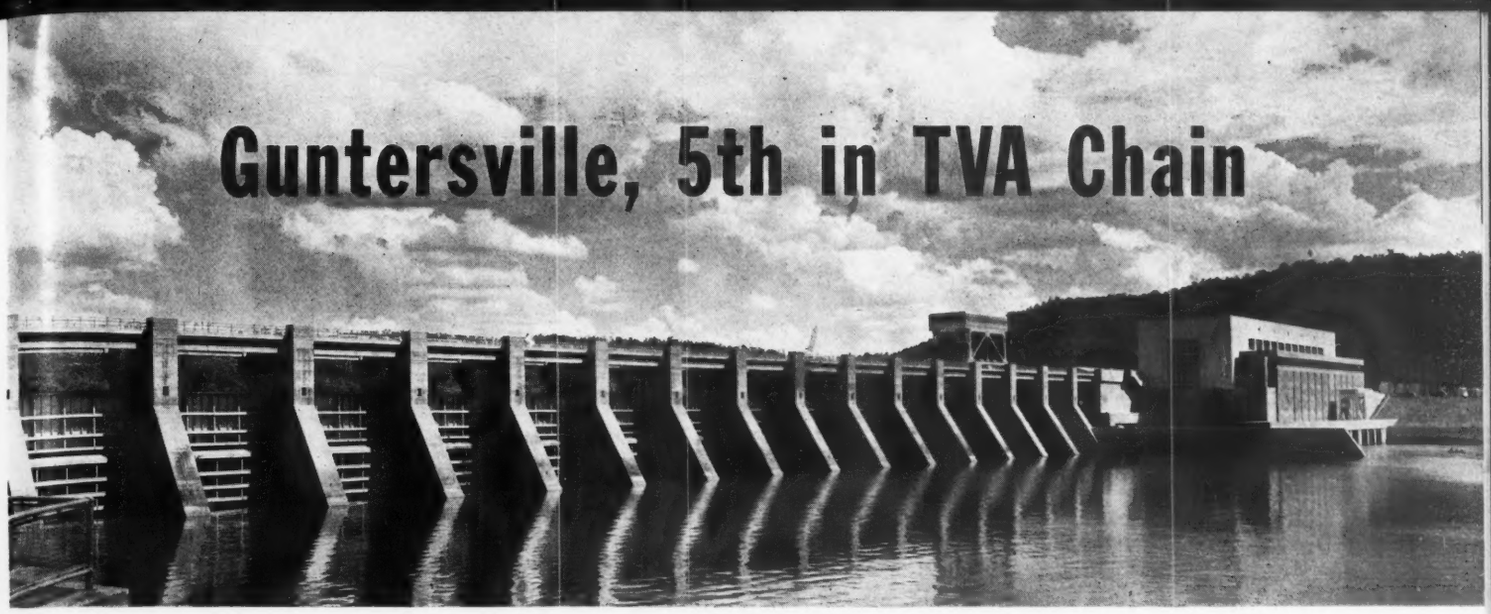
Put a grommet of wicking and white lead around the rod under the shoulder of the upset end and also under the iron washer. Draw the nut up tight.

If there is no space for inserting rod from hot end of tube, thread both ends of rod, and fit with nuts, washers and grommets.

This type of emergency repair should not be used for more than a month or two; the tube will be filled with water (from the defect) so that the rod will be corroded gradually. In time this might lead to rod failure and serious accident.

Operators sometimes plug defective tubes by driving tapered wood or metal plugs into both ends, with a sledge. Even as a temporary repair, this method may be dangerous. If a plug blows out, the sudden release of pressure may collapse the tube.

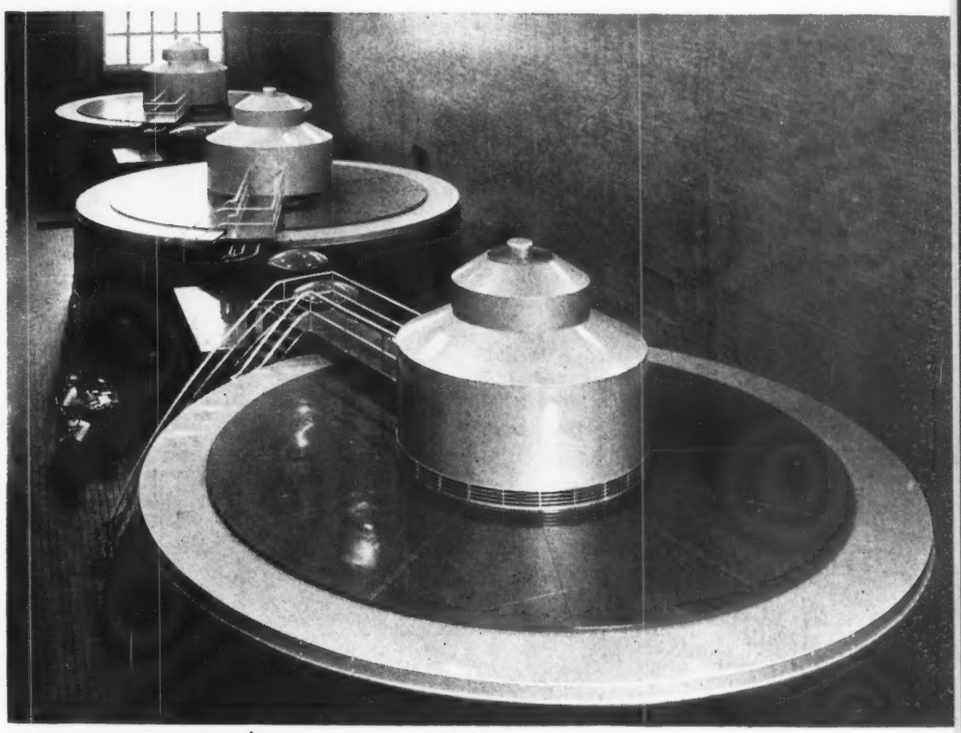
# Guntersville, 5th in TVA Chain



Down-stream side of Guntersville power house and dam with a total length of 4000 ft

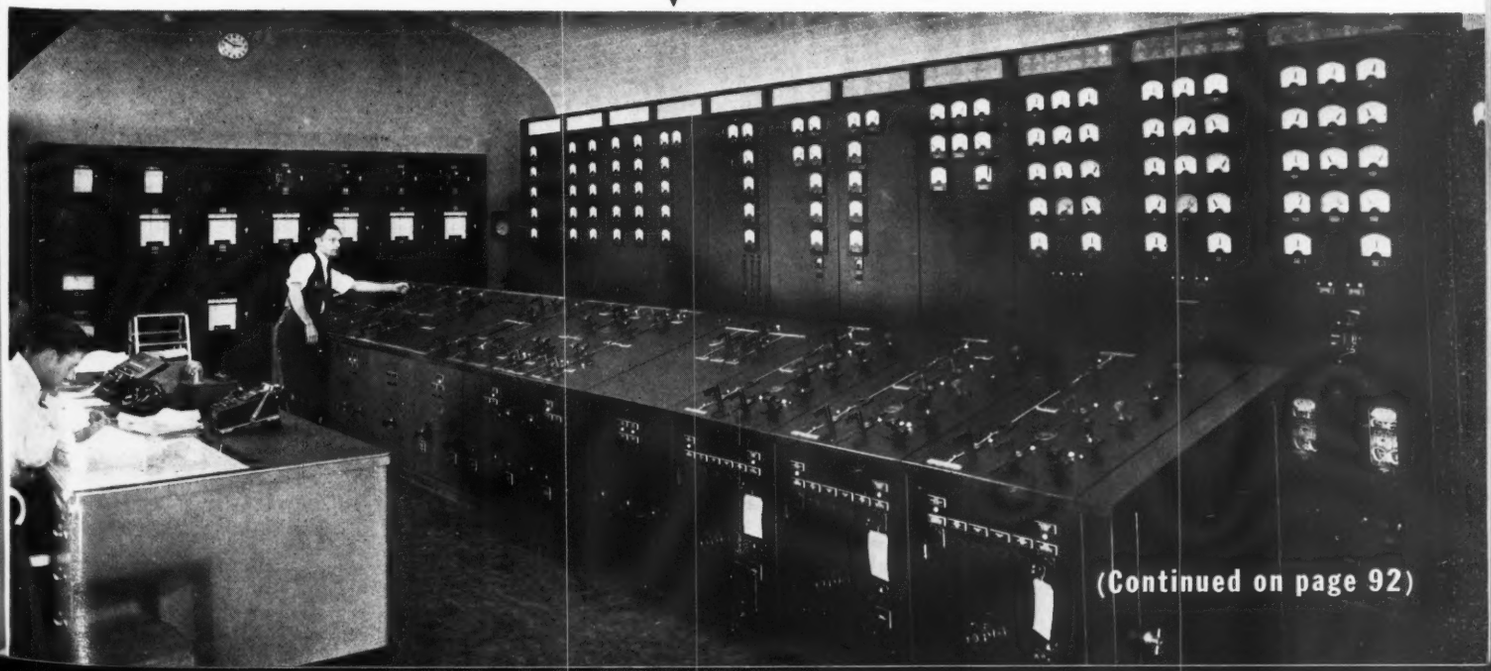
▶ At Gilbertsville, Ky., near the mouth of the Tennessee River, is the Kentucky hydroelectric project under construction, the first of the TVA chain on this river. 170 miles up the river in Tennessee, near the Alabama border, comes Pickwick-Landing plant, with 110,000 hp installed and space for 330,000 hp. Next is the famous Wilson-Dam plant with 260,000 hp installed, followed by Wheeler with two 45,000-hp units in operation, and then Guntersville, all in Alabama (see map, page 80, September POWER).

The latter includes a concrete gravity dam 4000 ft long, with a maximum height of 94 ft, which backs the water up the river about 50 miles to form a reservoir with an effective storage capacity of 242,000 acre-ft. The power plant has space for four 34,000-hp, 69.2-rpm, 36-ft head, Kaplan-turbine-driven generators (136,000 hp), three of which (102,000 hp) have been installed and placed in operation this year.



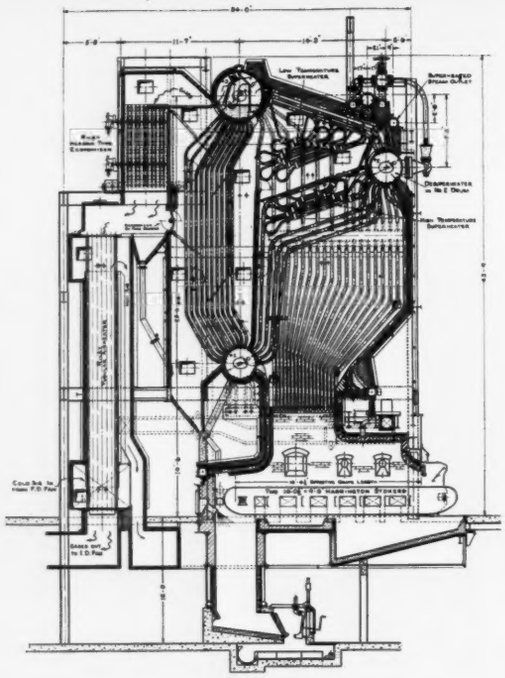
Power plant has three 34,000-hp Kaplan-turbine-driven generators installed and space for one more

Main switchboard room showing recording instrument board at left and bench board in foreground

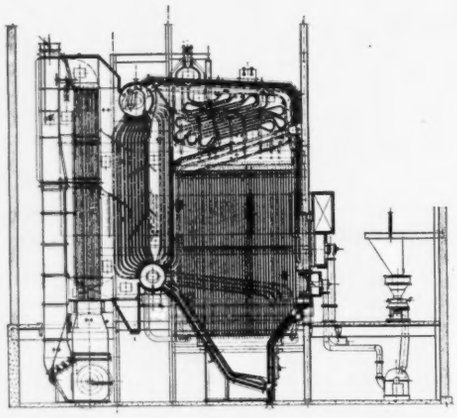


(Continued on page 92)

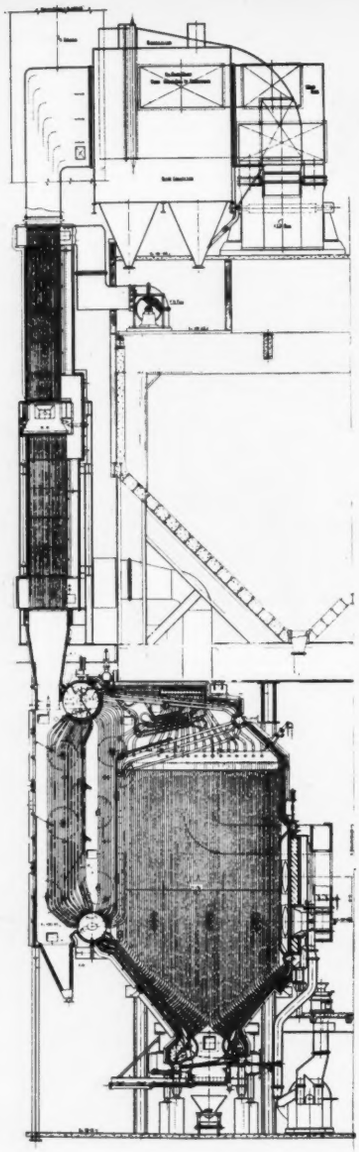
# A Page of RILEY



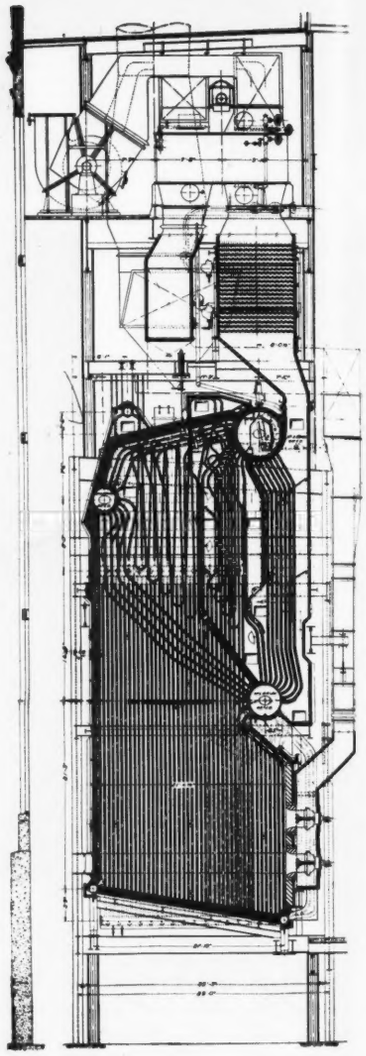
**UNION PUBLIC SERVICE COMPANY**
Canby, Minn.
75,000 lbs./hr. Riley Unit fired by Riley Pulverizers.
Unit operates at an efficiency of 87.3%.



**OTTER TAIL POWER COMPANY**
Wahpeton, N. D.
130,000 lbs./hr. Riley Unit fired by Harrington Traveling Grate Stoker. Unit burns North Dakota lignite at efficiencies in excess of 82%.



**UNION ELECTRIC COMPANY OF MISSOURI**
Ashley Street, St. Louis, Mo.
Two 285,000 lbs./hr. Riley Units fired with Riley Pulverizers. Third order for Riley Pulverizers from this company.



**LARGE FLORIDA PUBLIC UTILITY**
300,000 lbs./hr.
908 pounds pressure, 900°F. steam.
Unit fired by oil.

A few recent Riley central station installations are illustrated on these page
The selection of Riley Steam Generating Units by these outstanding compani
indicates the acceptance of Riley units by the Public Utility industry.

TRADE MARK Rx REGISTERED

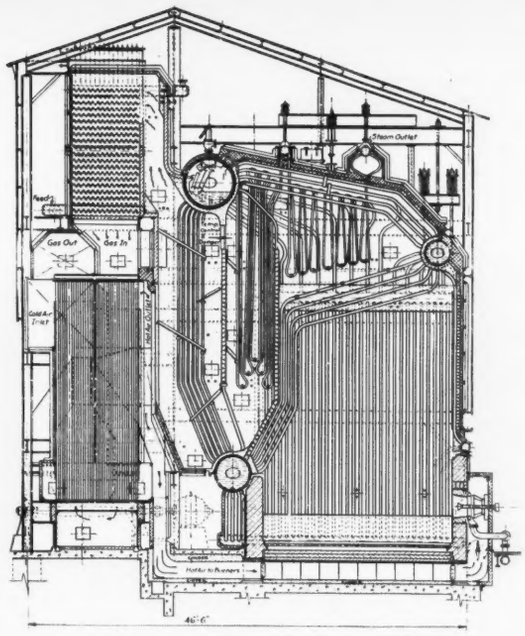
# RILEY

**STOKER CORPORATION, WORCESTER, MASS.**

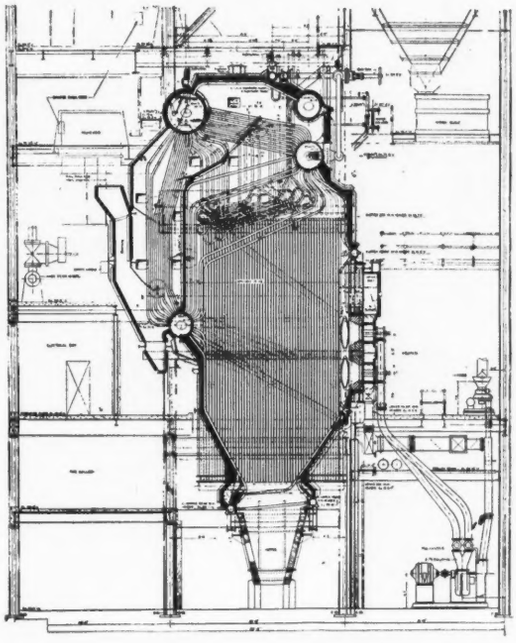
Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Den
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orle

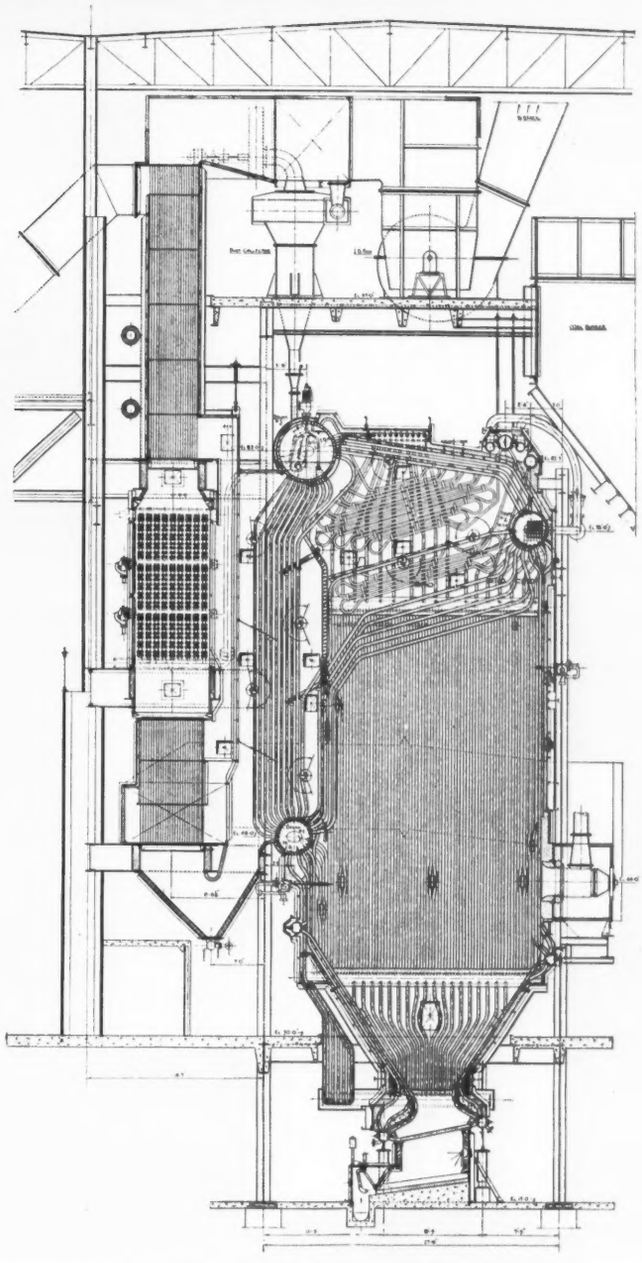
**It will pay you to visit modern Riley Installation**

# Public Utility Installations



LARGE TEXAS PUBLIC UTILITY
250,000 lbs./hr., 975 pounds pressure, 910°F. steam.
Unit fired by oil and gas.





CENTRAL ILLINOIS LIGHT COMPANY
(Commonwealth & Southern Property)
Peoria, Ill.
375,000 lbs./hr., 900 pounds pressure, 900°F. steam. Pulverized coal fired. Central Illinois Light Company also installed a 300,000 lbs./hr. Riley Unit in 1937.

← LYNN GAS & ELECTRIC COMPANY, Lynn, Mass.
205,000 lbs./hr. Riley Unit fired by Riley Pulverizers.

*A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs*

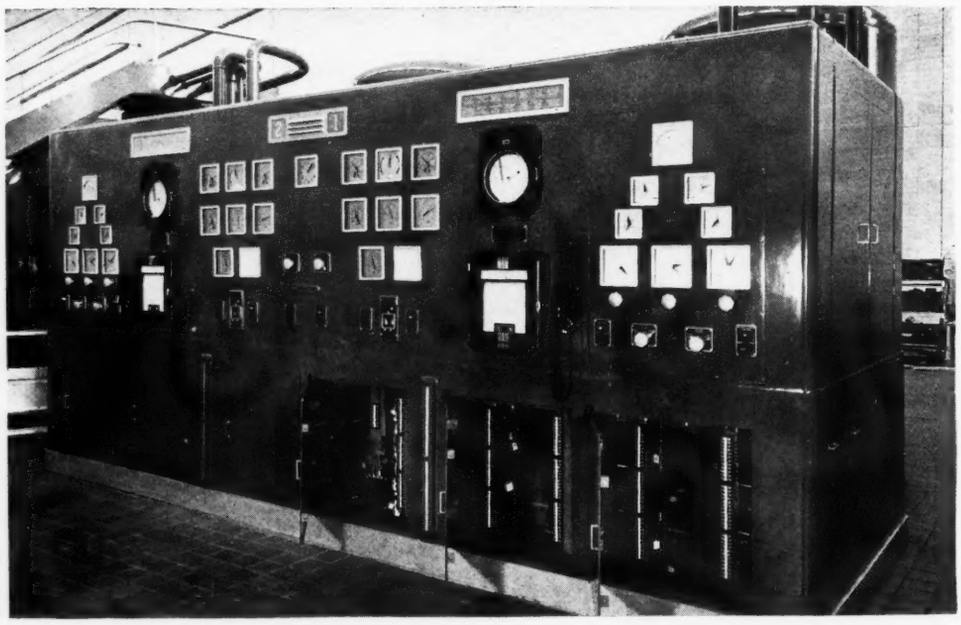
# COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

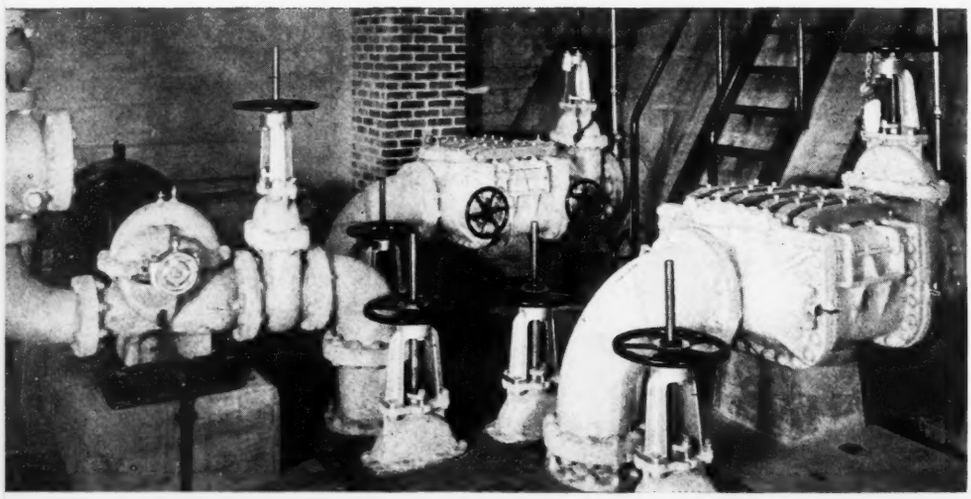
**before purchasing Boiler or Fuel Burning Equipment**

# Guntersville, 5th in TVA Chain

(Continued from page 89)

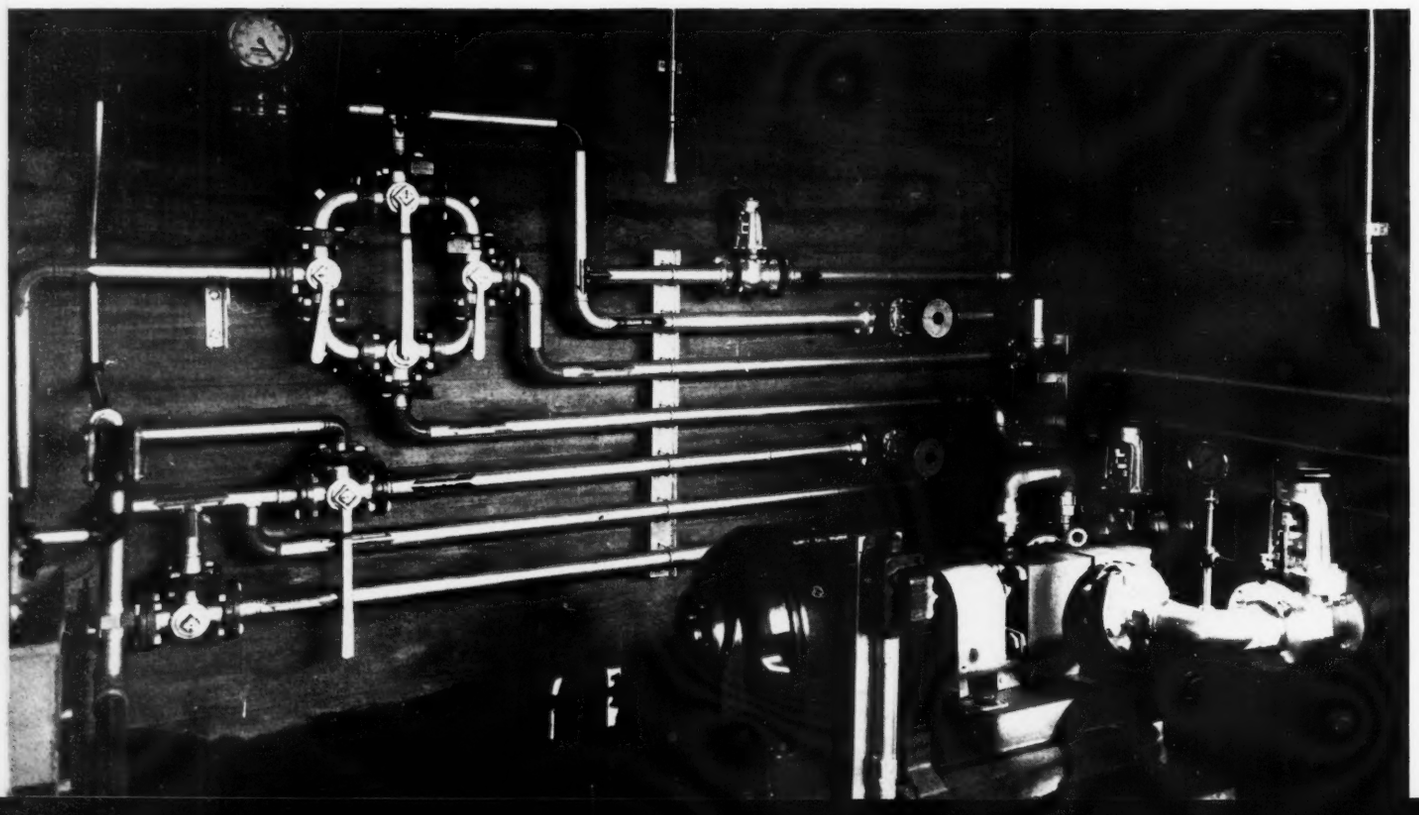


Governor and control cabinet for Nos. 1 and 2 units. Inside this cabinet are the electrically driven actuators, pressure-oil pumps, pressure-oil tanks and other governing equipment



Emergency, 1300-gpm cooling-water pump along with the intakes and twin strainers for the fire and service-water pumps. Two other 1300-gpm pumps supply water for lubricating-oil and generator-air coolers

A corner of the oil room showing the dirty-oil pump and part of the oil piping. Arrows on the piping indicate kind of oil and direction of flow



# Engineered for Air Conditioning

***Engineer and architect cooperate from the ground up to produce a truly modern building, combining efficiency and long-run economy, for Bankers Life Insurance Co, Des Moines, Iowa***

▶ COORDINATED DESIGN of structure and services, unique combination of modern materials and equipment, and foresighted planning at every point make the new Bankers Life Building, Des Moines, Iowa, worthy of close study by building engineers. Whether or not it forecasts the buildings of the future, it remains an outstanding example of what engineers and architects can do when they cooperate from the ground up to produce a truly modern structure. Charles S Leopold, consulting engineer (Philadelphia), and Tinsley, McBroom & Higgins, architects (Des Moines), integrated their efforts at every stage to produce a building of maximum efficiency and one that would be, in the long run, most economical.

### *Uses Wall Warming*

This $1,500,000 home office of the Bankers' Life Insurance Co is thought to be the largest commercial building recently erected in this country with private capital. Its six stories and penthouse provide working facilities for the large clerical staff as well as club rooms, gymnasium, locker and shower rooms, game rooms, kitchen, and a roof terrace. A typical office floor consists of an open space 235 ft long and 53 ft wide, with wings at the ends 90 ft deep; there are no columns or obstructions of any sort from wall to wall. Use of wall-warming in addition to conventional air conditioning helps make this possible and the general design of the structure greatly facilitated installation of air conditioning, lighting and other services.

Rainbow granite forms the exterior to a height of 23 ft; above this point walls are of limestone. Corkboard, 2-in. thick, provides insulation. Double-pane casement windows set in glass-block panels insure ample natural light without excessive infiltration and sweating in winter. On five working floors, steel panels, enameled at the factory, form the interior surface. Rubber tiles rest on a concrete floor; the underside of the floor has a combination sound and heat insulating pad forming the upper part of a plenum, the lower part of which is a perforated metal ceiling aiding even air distribution to the space below.

Metal coffers extending up into the air space contain the lighting fixtures, which produce better than 30 foot candles on the working surface. This arrangement provides a simple means of removing a portion of lighting heat load, and gives efficient illumination without use of pendant fixtures. The inverted and smooth coffer surface defeats dust accumulation and facilitates cleaning when necessary. Changes in floor layout can be made without any structural disturbance.

Although the air-conditioning system can heat the building independently, partial panel heating, or wall warming, eliminates cold drafts close to wall and glass surfaces and reduces radiation from the body to these normally colder areas. This supplementary heating makes it possible to utilize floor space right up to the walls, adding about 8% to the useful floor area. Wall warming and use of clear spans in place of short column-supported spans is justified by the fact that space saved is equivalent to an additional floor.

Continuous bare copper pipes, 1-in.

**Fig. 1—Wall-warming pipes in space between corkboard insulation and enameled-steel panels make floor area near walls fully usable**

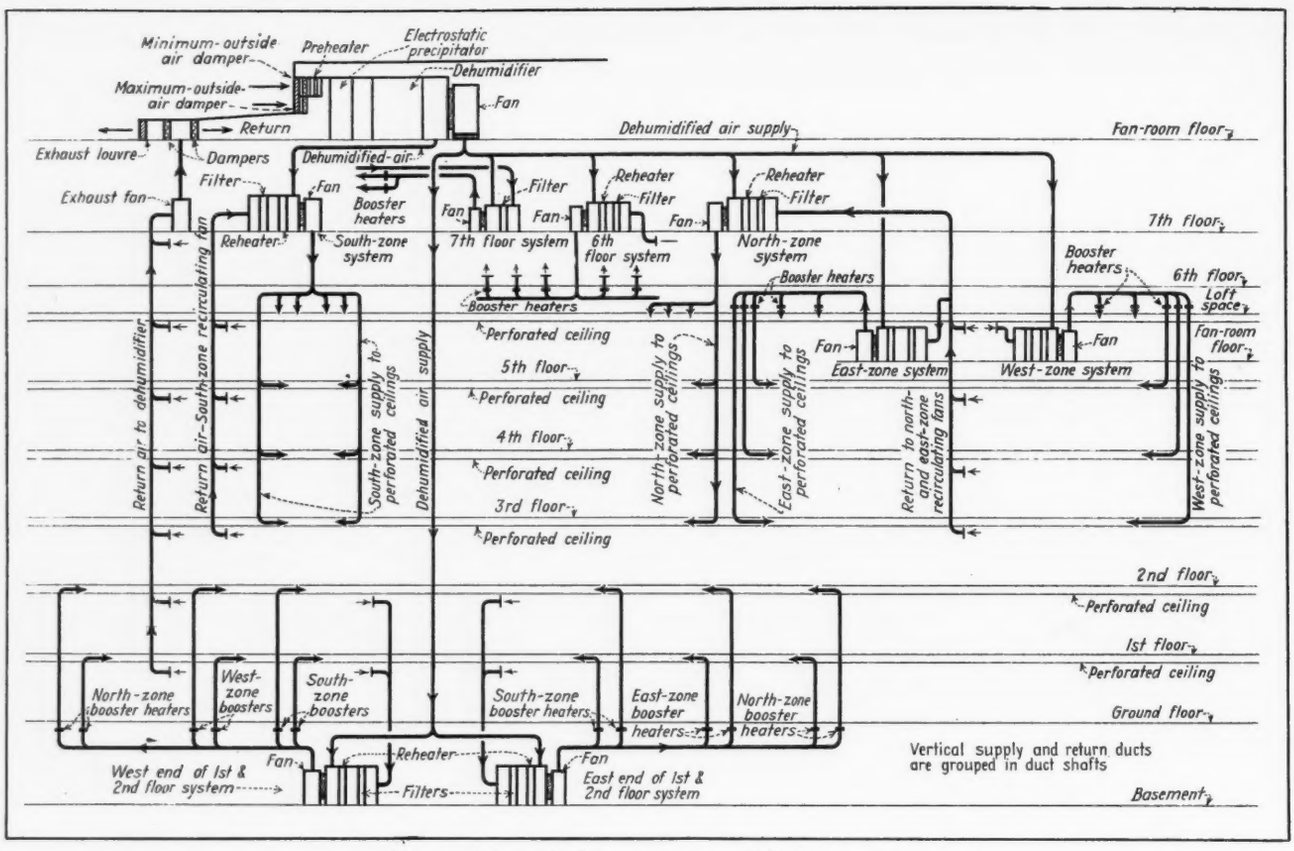



**Fig. 2—Schematic layout of air-conditioning system**

diameter, running along the walls and around the windows, see Fig. 1, fit in the space between corkboard insulation and enameled-steel finishing plates. These pipes carry hot water in winter, raising wall temperature sufficiently to produce a combined wall and window radiating temperature of approximately 70 F. Local hot spots adjacent to radiators are eliminated. In summer the pipes carry cold water, but it proved economically inadvisable to provide capacity enough to counteract full sun load on one side of the building. During winter months, the wall-warming pipes will keep the building at reasonable temperature when unoccupied, reducing the time required for bringing the system to operating conditions to considerably less than one hour.

### *System Layout*

Supply and return air is distributed throughout the building, in the main, by vertical utility shafts. Fig. 2 shows, schematically, the system layout. Fresh air from preheaters mixes with part of the return air before entering a 124,000 cfm, 180-cell, electrostatic precipitator, installed to remove smoke particles which would pass through conventional filters (Fig. 3). An air washer adds or removes moisture as needed and also takes care of summer cooling.

Conditioned air flows to a main supply fan which serves seven local recirculating units, supplying various building zones. A single fan in the penthouse exhausts air from the conditioned spaces, discharging a portion outside and the remainder to the conditioning apparatus. A separate washer serves the auditorium behind the main building; a coil-surface unit conditions part of the basement while the remainder, serving as a storage, is ventilated but not conditioned.

The basic control setup for the working floors divides them into four zones according to the points of the compass, with separate supplies for each. Wall-warming piping is similarly divided. In each zone, thermostatic control regulates temperature and humidity of supply air and temperature of water in wall piping, thus allowing for variations in sun exposure and wind direction. Booster heaters in individual supply ducts provide independent control for private offices on the 6th floor.

Three 15x10-in., vertical, single-acting, Freon-12 compressors produce 650 tons of refrigeration required for cooling. A 150-hp, 4000-volt, synchronous motor drives one 2-cyl unit, while 300-hp motors drive the two 4-cyl units. Capacity controls on compressor cylinders permit reduction of output in 4 steps to 87½, 75, 62½, and 50% of rating. The engine room forms an impressive showplace and visitors can look down into it through large plate-glass windows in a balcony at one end (Fig. 5).

Compressors discharge through pulsation tanks into a pair of horizontal multi-pass shell-and-tube condensers. Automatic purging saves refrigerant and reduces power requirements. The cooling tower is built into the rear wall of the penthouse, as a continuation of the stair tower, and forms an integral part of the architecture. Liquid refrigerant passes to two receivers and into two spray-type water coolers, equipped with liquid pumps and float valves. The chilled water circulates to washers and the coil-surface conditioner.

### *Flexible Hookup*

One condenser and one evaporator serve each of the 4-cyl machines; the 2-cyl unit may be used with either evaporator and condenser, or the entire setup may be operated as one system. This gives operating flexibility and protects against failure of any one piece of equipment. Floating foundations and cork isolators insulate against transmission of vibration and noise.

Three automatic oil-fired boilers supply hot water for wall-warming and for general building service. An operating panel on each shows pressure, overfire draft, and smoke density; a separate panel carries $CO_2$ recorders. Remote indication of smoke density in

Fig. 3—Electrostatic precipitator removes smoke particles which cannot be effectively eliminated by ordinary filtering

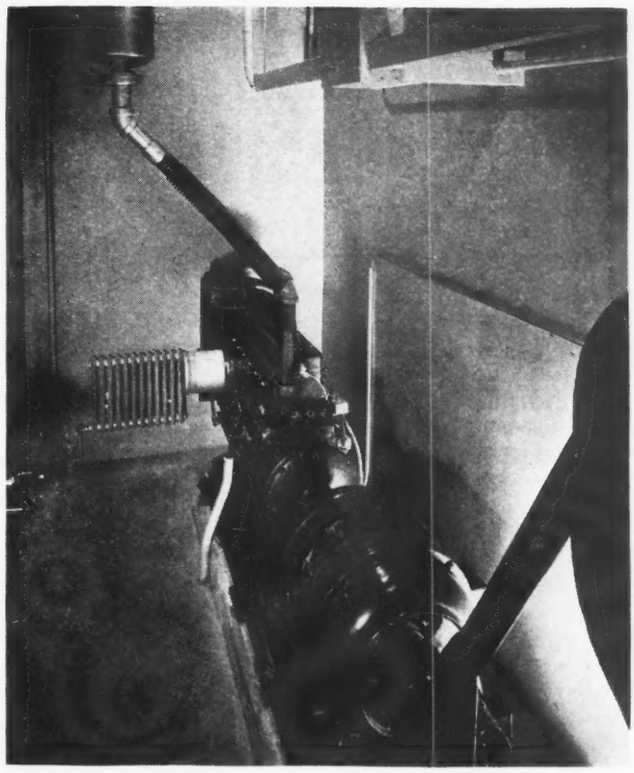


Fig. 4—Automatic diesel-generator set goes into service when outside current fails, supplying emergency lighting

Superintendent Mike Johnston's office warns of objectionable smoke.

The emergency power source is an example of the foresight that went into this building's planning. A "quietized" room in the penthouse contains a 60-hp diesel-generator set, mounted on vibration dampers to eliminate shock (Fig. 4). Failure of regular current supply will automatically bring this unit into action, supplying emergency lights in the auditorium, stairwells, elevators, and all exits. The unit continues in operation until outside current is restored and then shuts down automatically. Louvres in the exterior wall open automatically when the engine starts, to provide fresh air and remove fumes.

Operation of the air-conditioning and other building services is centralized in the engine room at an 8-panel control desk and switchboard (Fig. 5). Three panels mount compressor-motor controls and three carry controls for chilled-water, condenser-water and other auxiliary pumps. A center panel covers fans, spray pumps, compressors, radiant heaters, booster heaters, boilers and electrostatic precipitators, with a master thermostat at the top.

Another central panel contains selector switches for a 24-point electrical thermometer at the center of the control desk, which gives the operator instant data on conditions in all parts of the building. An electrical recorder above the thermometer keeps a running record of temperatures whose trend is important: outside wet- and dry-bulb, apparatus dewpoint, fan discharge, and return air. Flowmeters for condenser water and chilled water stand on either side.

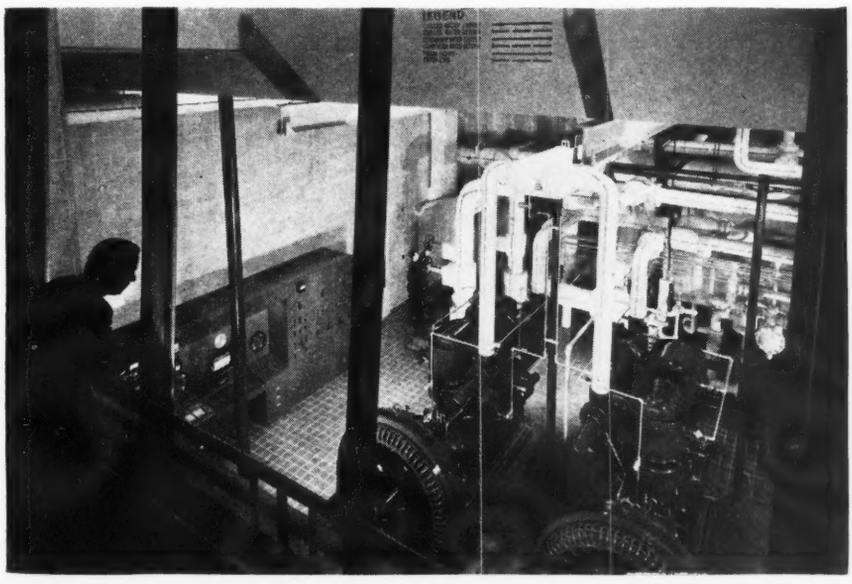


Fig. 5—View from visitors' balcony shows synchronous-motor-driven Freon-12 compressors (one of three units not visible) and central control desk and switchboard

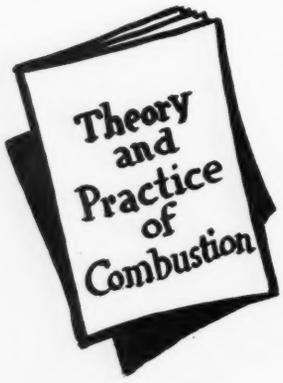
### *Instruments in Office*

All these instruments appear on a similar board in the superintendent's office, which also contains a $CO_2$ recorder and dials indicating fuel-oil supply in the three tanks, which have a combined capacity of 16,500 gal. This board contains no start or stop buttons for equipment operation.

Records include a daily log containing 57 2-hour entries, covering all phases of the air-conditioning and heating system, as well as a daily metering report covering electric energy, fuel, and water. These records permit an accurate check on costs and provide the basic data needed to determine best operating practice.

# Speaking of Power

This editing job seems to be a form of perpetual motion. As soon as we had launched our 24-page "Power for Defense" section (September), we started laying the keel for "Combustion"—an equally ambitious project for December POWER. . . . Some of the details are still to be worked out, but we expect to give you a regular handbook on the selection and burning of fuel, plus the clearest explanation of combustion theory and figuring you have yet seen. We plan to make this section, even the so-called theory, intensely practical. . . . This section, by




*Handbook on combustion*

the way, fits the national-defense picture perfectly. Geting the right fuel, and burning it right, are the first steps in the manufacture of munitions and war supplies of all kinds.

I had a pleasant week attending the 58th annual convention of the National Association of Power Engineers in Columbus, Ohio, August 19 to 23 (see page 120). Met a lot of old friends and had time for a few calls around Columbus. . . . For example, I ran out to Ohio State University to have lunch with Dean McQuigg (engineering), Dean Emeritus Hitchcock, Lawrence D Jones (secretary

*Medal for Dean Hitchcock*

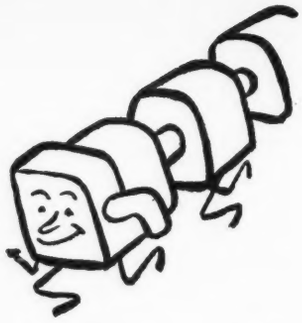
of the College of Engineering), Professors Roberts, Bucher and Brown of the ME Dept, and Professor Weed of the Engineering Experiment Station. . . . Dean Hitchcock told me he has subscribed to POWER without a break since 1892, a total of 48 years. He wants to know if anyone can beat that record. . . . Professors Bucher and Brown showed me around the extensive laboratories and shops — also the university power plant. This heats all the buildings (hot water) and supplies all electricity used in serving 13,000 students. Installed turbine capacity is 7000 kw, and an additional unit will be required in a few years. . . . This was my first visit to Ohio State University, and I was much impressed with staff and plant.

Luckily my Columbus explorations led me out to the Battelle Memorial Institute, one of America's most important research establishments. Every power man ought to get acquainted with Battelle, where scores of scientists are reshaping his job with innumerable researches, particularly on coal—all the way from mining methods, through preparation and pulverizing to burning, both on stokers and in pulverized form. . . . As Ralph A Sherman, supervisor of the Fuels Division, took me all over the Institute, I was tremendously impressed by the variety of projects under way, the quality and quantity of equipment, the many evidences of scientific method and practical horsesense teamed up in pioneering ventures. . . . Endowed in the will of Gordon Battelle, as a non-profit research organization, the institute started out in 1929 with a staff of 49. Today over 220 men, mostly scientifically trained, are at work in buildings with 175,000 sq ft of floor area. Some of the fundamental research is handled by Institute funds, but most projects are conducted at cost for industrial sponsors. Research activities are assigned to 12

*Reshaping engineer's job*

technical divisions, each with its own supervisor; the entire institute is directed by Clyde E Williams.

On another day I joined a small group of NAPE delegates driving out 10 miles to see the high-pressure "condensing-top" turbine at the Walnut Station of Columbus & Southern Ohio Electric Co. Equipped with the necessary passes from chief engineer C Z Gillivan, we were escorted through the plant by O H Cleveland, superintendent of power, and R L Powell,



*Condensing top runs smoothly*

superintendent of Walnut Station. . . . The new 30,000-kw, 3600-rpm Westinghouse turbine ran much quieter and smoother than the usual old-style 1800-rpm machine. Steam comes to the throttle at 1250 lb and 900 F. Note that this is not a straight top. About half the steam bleeds to old turbines at 250 lb, the remainder expands through the low-pressure cylinder to condenser pressure. The unit is very neat, compact and hydrogen-cooled. . . .

A while back, we were cussing the fates because there weren't enough utility stories to fill our budget. Now, the shoe is on the other foot and it pinches. . . . Announcements of new units pour in on top of preceding ones, but even the flintiest-hearted editor hesitates to ask an operating engineer for a story, that is, if he can be dug out of construction debris of Unit 2 and specifications for Unit 3 long enough to be asked. . . . However, we are managing to

*Utility readers to profit*

corner and cajol enough engineers into giving us details on the cream of new design so that 1941 will be profitable for utility readers.—*PWS*

# THE OPERATING ENGINEER

George Edwards
*Advisory Editor*

**Practical Aids**
**Maintenance Hints**
**Questions — Answers**

**Published monthly as an integral part of POWER**

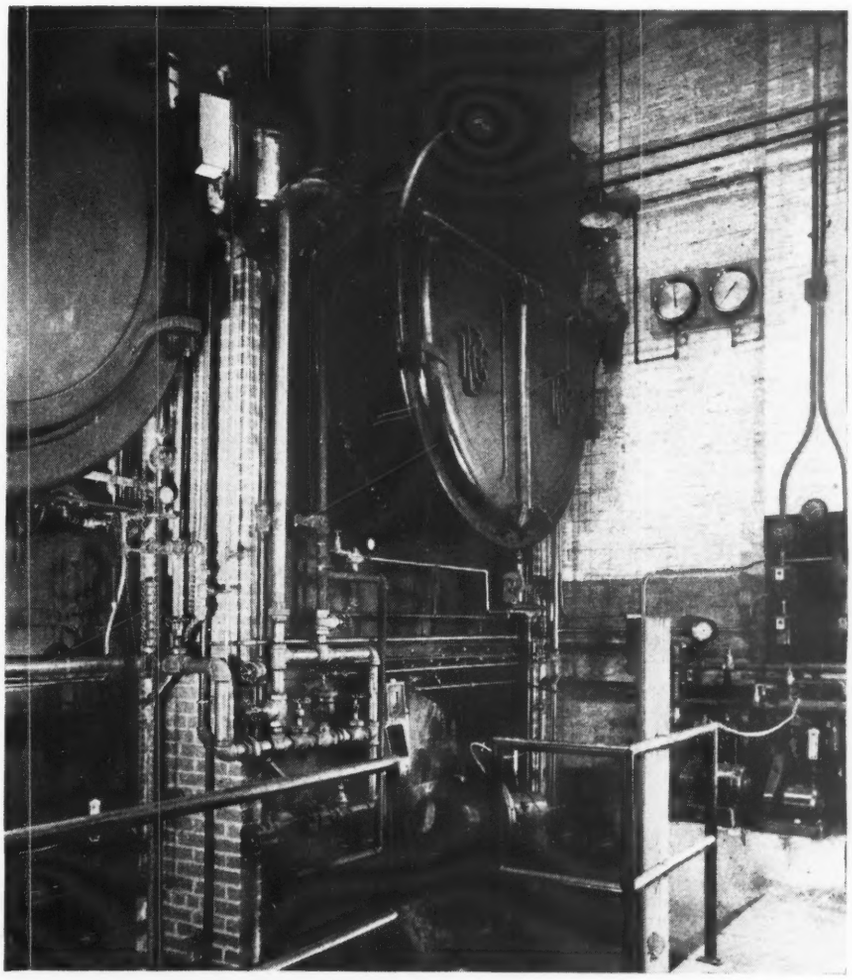
# *Clean-Cut Design, Careful Operation Produce Results*

***New England Laundry Co, Hartford, Conn., presents a worthwhile example of modern power practice in an average-sized plant***

IF YOU SAT DOWN to layout a power plant for a typical laundry, what would it be like? Well, you'd want modern equipment for efficiency and you'd take advantage of all the heat-reclaiming possibilities in power and laundry operations so as to generate nearly all your kwhr as a byproduct of necessary steam generation. If years of operating experience had made you power-wise, you'd choose simple, rugged equipment and avoid too-fancy hookups and extra gadgets, because you'd know that reliability and easy maintenance count for a lot in a small plant.

After figuring and scheming, it's dollars to doughnuts that you'd come out with something closely resembling the plant at the New England Laundry Co, Hartford, Conn., a typical modern laundry installation. This company was founded in 1891 and the present up-to-date building (begun in 1929) is the third occupied during this period. At first, a Bigelow 2-pass boiler was installed for steam generation and power was purchased, but in 1937 operations were consolidated in this building, which was extended, and the present power equipment was installed.

Two oil-fired hrt boilers supply all steam requirements, operating at 150 lb saturated. One, an Ames Iron Works unit with 2340 sq ft of heating surface, was installed in February, 1937, while the other, a 2600-sq-ft Bigelow boiler,



**One end of boiler room, with oil-fired hrt boilers at left and oil pumps at right**

went into service in October, 1938. Both have Petro burners.

Trucks deliver Bunker C oil to the plant's two 3000-gal underground tanks, fitted with live-steam coils. Two motor-driven oil pumps transfer fuel from the tanks to two live-steam preheaters, thermostatically controlled to maintain 180-F oil temperature. Originally, this equipment was arranged so that each tank, pump and heater formed a separate and independent circuit. Kenneth Denton, operating engineer of the plant, wanted more flexibility than this setup provided and repiped the units with cross-connections so either pump can be used with either tank or heater.

The relatively high settings (8 ft) promote combustion efficiency and eliminate flame impingement. There is a short target wall about halfway back and wing walls stand on each side of the burner. A recent checkup shows that average flue-gas temperature runs about 500 F and $CO_2$ ranges between 10 and 11. The Ames boiler is fitted with a steam-operated automatic flue blower, while hand blowing is relied on for the Bigelow unit. Denton finds that blowing once a day gives satisfactory results and that no noticeable improvement results from more frequent cleaning.

The semi-automatic burners require manual lighting off but go from high to low flame, and reverse, automatically. Combustion control centers in a Julian d'Este damper regulator which ties boiler outlet damper, and primary and secondary air, to steam pressure. An 80-ft high, 5-ft diameter steel stack provides draft.

Live steam from the boilers supplies the 3-cyl, 10½ x 11-in., 450-rpm vertical Ames engine which constitutes the main power supply. A 20-kw utility service takes care of starting-up requirements and night lighting loads. The engine drives a 175-kw General Electric ac generator with V-belted exciter. The generator is wired for 2-phase 4-wire operation, to match Hartford's utility service.

Engine exhaust goes to a Patterson-Kelley tubular closed feedwater heater, then an oil separator of the same make and to two 2500-gal hot-water storage heaters. Condensate flows to a 600-gal receiver before return to the boiler by two Worthington duplex pumps, one 6 x 4 x 6 in., the other 7½ x 5 x 6 in.

### *Process Steam*

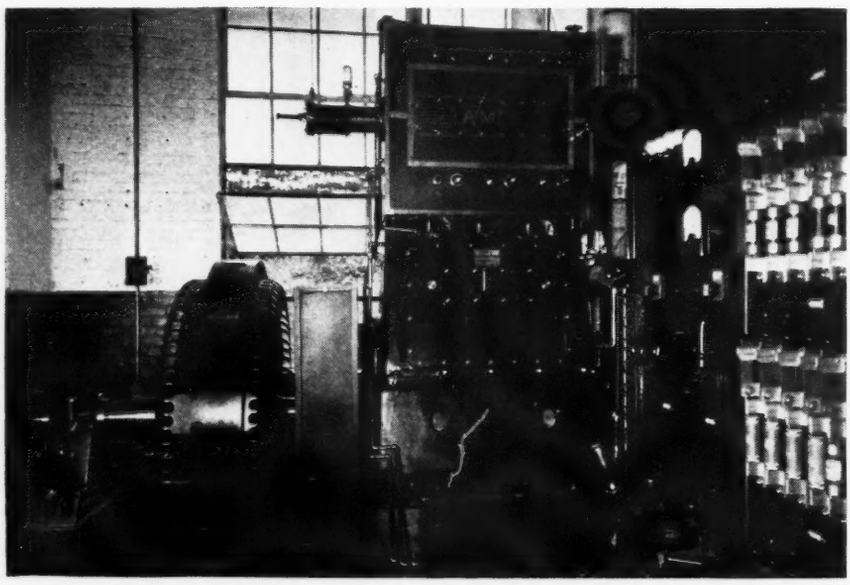
Since water heating utilizes all engine exhaust in winter and practically all in summer, other process-steam requirements must be met by steam from the boilers. Reducing valves drop boiler steam to 100 lb for laundry heating equipment and to 3 lb for building heating. Use of steam for dry cleaning increases makeup slightly; this runs about 20% in winter and 30% in summer. Makeup comes from the city mains and since Hartford enjoys a good water supply (2 grains hardness, maximum), a little soda ash keeps feedwater in the right shape for trouble-free operation. Denton uses a straight mineral oil for engine lubrication and has experienced no difficulty with oil in the exhaust steam.

Laundry water passes first through a preheater where it picks up Btu's from the waste hot water dumped from the wash wheels and then goes to the main heating tanks. These are equipped with live-steam coils as well as exhaust-steam heating surface; this takes care of periods when engine exhaust and hot-water requirements get out of step.

A heat-reclaiming arrangement fitted to the dry-cleaning process saves additional Btu's and prevents water waste. In this process, it is necessary to condense a vapor; water flowing in a closed circuit does the condensing. To remove the Btu's picked up in this operation, heat is transferred from the circulating water to a portion of the water flowing from the preheater to the main hot-water heaters. The exchange takes place in a 1000-gal storage heater.

Modern equipment and a good hook-up aren't enough—they must be backed up by conscientious and intelligent operation. Laundry plants must be dependable; each day's work must be done the same day without interruptions caused by power or steam failure. Reliability counts most in the early days of the week when loads are heaviest; work in the laundry slacks off from Thursday noon to Saturday noon when the plant shuts down for the week end. This gives a breathing spell each week for inspection and maintenance.

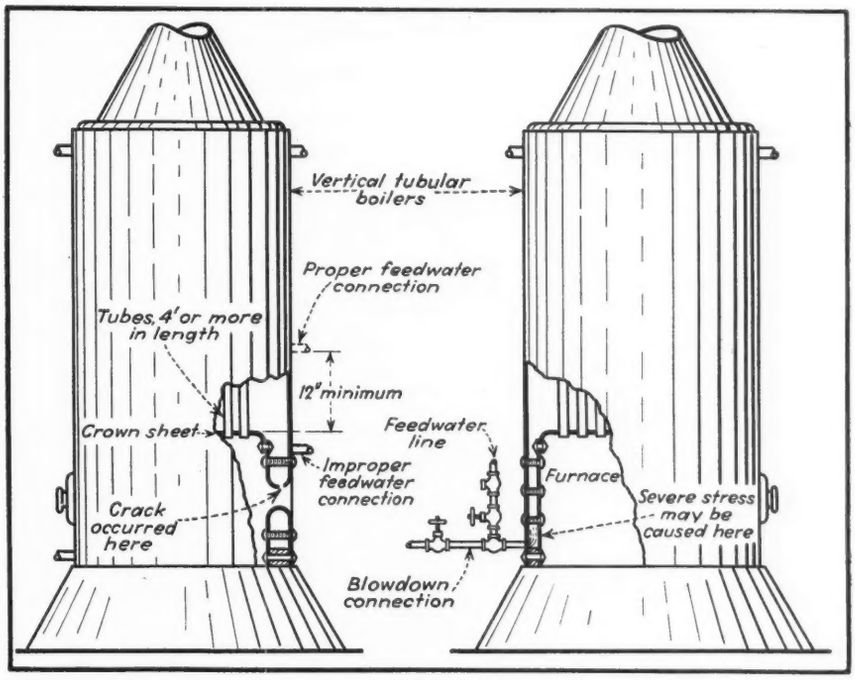
Routine maintenance at the New England Laundry includes scraping boiler tubes at 2-week intervals (boilers are washed out twice a year). Incidentally, the boards fastened to the railing in front of the boilers (see photo) serve as permanent supports for the staging erected when the tubes are cleaned. Thus far the engine has required little or no maintenance, but Denton keeps a close watch on its day-by-day operation. In addition, he takes up the bearings and inspects thoroughly once a year.



**Almost 100% utilization of exhaust from this 3-cyl, 10½x11-in., 450-rpm vertical engine insures low-cost power generation**

# *Watch That* **FEEDWATER** *Connection!*

***Two case histories show that trouble and expense result from disregard of Code rule for location of feedwater connection in vertical tubular boilers***




**Both these feedwater connections disregard the Code rule—both lead to troublesome repairs**

RULES AND REGULATIONS dealing with steam boilers, particularly the ASME Code, rest on good engineering reasons. Understanding the reasons for the making of a rule goes a long way toward insuring faithful following of its instructions.

For example, refer to P-314 of the ASME Code for Power Boilers, relative to the introduction of feedwater into vertical tubular boilers. This section reads: "In vertical tubular boilers having tubes 4 ft or less in length, the feedwater shall be introduced at a point not less than one-fourth the length of the tube above the lower tube sheet or crown sheet. For tubes more than 4 ft in length, the feedwater shall be introduced at a point not less than 12 in. above the crown sheet."

For an extreme case of disregard of this rule, take a look at the right-hand sketch. Here we see the comparatively cold feedwater discharging through the blowdown line into the waterleg directly against the hot furnace sheet. In addition to the thermal shock, each pulsation of flow causes extreme fluctuation of furnace-sheet temperature *and stress*.

In one installation, a 6-in. crack recently developed between staybolt holes in the area exposed to these expansion-contraction stresses. Expensive repairs were required which could have been avoided by following the rule.

### *Sludge Removal*

In addition to undesirable stressing of the furnace sheet, this method of feeding water defeats an important purpose of the blowdown. This is to remove the precipitated sludge from the waterleg. Flow of water into the boiler through the blowdown line washes the sludge to remote parts of the waterleg from which removal by normal blowing down is difficult if not impossible. In these places, sludge may build up and cause overheating and damage to the furnace sheet.

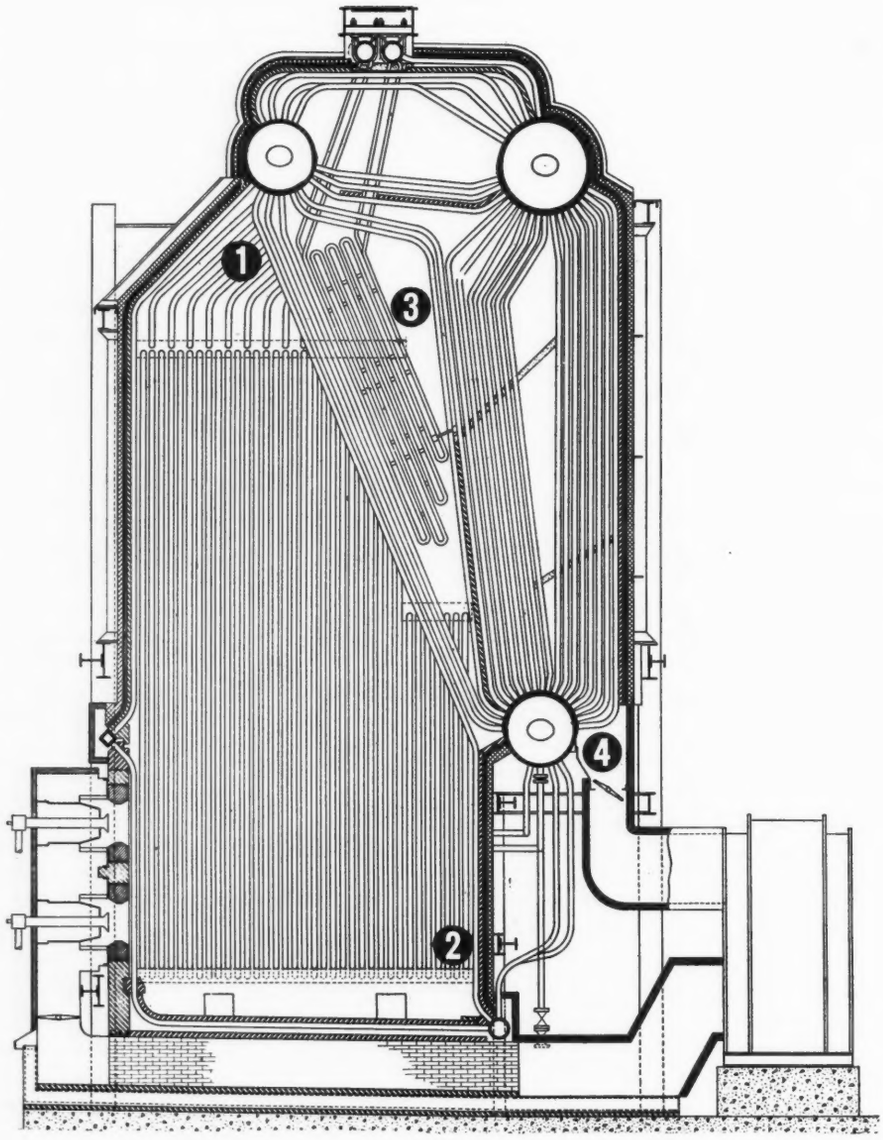
The connection shown on the left side of the sketch represents another and different departure from the Code requirement. Here the feedwater enters slightly above the furnace mouth; the cold water joins the normal circulation in the boiler and is carried downward directly against the flanged joint of the furnace mouth. The opposite side of the joint is exposed to radiant heat and high temperature.

Such a connection often produces persistent cracking and leakage from this joint. In one plant, the furnace-mouth seam was caulked against leakage but the leaking continued. Finally, welding was attempted but in a short time a leak developed through the seam. After changing the location of the feedwater line to that specified by the Code, and shown in dotted lines, no more difficulty was experienced in this particular case.

These actual cases serve to emphasize that this rule, like other Code rules, was drawn up to prevent operating difficulties, excessive maintenance costs, and hazardous conditions.

# *How Many* **DRAFT GAGES** *and Where?*

***W H Pugsley, The Hays Corp, gives practical data on the number of draft gages needed and how to locate them for various furnace and boiler arrangements***




▶ THE NUMBER AND LOCATION of draft measurements depends on the boiler layout. This article shows where connections should be provided, either for test or operating purposes, in typical furnace and boiler arrangements. To determine where draft measurements are needed on your boiler, select those items that fit your particular set-up and ignore the rest. Future articles will show how and where to locate draft connections for boiler auxiliaries such as forced- and induced-draft fans, air heaters, economizers, and dust collectors, and also for different types and arrangements of firing equipment.

### *Furnace Draft*

One gage is of prime importance for operating purposes; it should measure draft at one point in the furnace representative of, and bearing a definite relationship to, the draft throughout the entire furnace. The measurement is usually taken at the top of the furnace through the side wall, at a location about 12 in. below the first row of boiler tubes and near the high point of the furnace proper, see illustration, (1).

In large furnaces, and especially high ones fired with pulverized fuel, oil, or gas, several test connections are usually made near the bottom or end of the furnace (2) to check the design and to assist in determining the proper burner setting to secure a furnace full of combustion yet avoiding flame impingement. These test readings also indicate the relationship between the draft maintained at the top of the furnace and that existing in other parts.

*Natural Draft:* When natural draft is used, it is necessary that the furnace draft increase as load increases in order to create a difference of pressure across the grates and fuel bed (or burner in the case of gas or oil) to cause a flow of air sufficient for the rate of combustion required. In general, to obtain highest combustion efficiency consistent with the character of the steam generator, the lowest possible draft that will burn the amount of fuel needed to carry the load should be used. The range of indicator used for this purpose is never over −1.0 in. and usually −0.75 in. is enough.

*Forced Draft:* With forced draft, the furnace draft is generally held constant at some value between +0.00 in. and −0.15 in., at the highest point in the furnace. This means that the lowest possible draft will exist at all times throughout the entire unit, without a pressure occurring at any point. Pressure would cause gas, smoke and heat to escape into the boiler room. Too much draft or *negative* pressure causes infiltration of air into the furnace, diluting and cooling the gas, causing, in turn, low $CO_2$, high exit-gas temperature, and reduced efficiency. Range of indicator used is usually either +0.10 to 0.0 to −0.60 in. or +0.20 to 0.0 to −0.50 in.

### *First-Pass Draft*

When low-fusion-temperature fuel is burned, which is apt to slag the boiler

tubes, a draft indicator connected at the top of the first pass, back of the first bank of boiler tubes, or superheater if one is installed, (3) gives an indication of the draft at that point. The difference between this reading and that of the furnace draft gage represents the loss through that part of the boiler. If this draft loss becomes excessive, it warns of increased resistance, due to slagging and soot deposits.

### *Last-Pass Draft*

This always important measurement (4) bears a definite relationship to the boiler load and the difference between this reading and the furnace-draft reading represents the draft loss for the boiler for the rating and $CO_2$ at which it is operating. Boiler manufacturers usually guarantee this loss, which is important in determining stack size and height, or induced-draft fan capacity.

With manual control, this reading tells the operator how to control air for combustion; by knowing draft required for any desired rating he can quickly set the boiler outlet damper or induced-draft-fan speed to produce the required draft. Draft loss across a boiler is frequently used as a measurement of air volume for automatic control and when such is the case operation of the control will be materially improved with a higher draft loss.

A material change in the draft-loss characteristic of a boiler indicates a change in resistance of the gas passages, caused by slagging or soot deposits if an increase, or by leaky baffles if a decrease.

### *Special Conditions*

If the boiler is of the double or divided type, having two separate passages for gas, a duplicate set of measurements is required for each boiler section. Boilers equipped with slag screens require a measurement on the boiler side of the screen for both test and operating purposes. Design checks, periodic tests, and occasionally acceptance tests require a measurement at each end of a boiler pass and at each side of a superheater of the interdeck type. Such measurements are, however, unnecessary for operation.

✦ ✦ ✦

# BOILER ROOM "DON'TS"

***Ed Duff passes along some pointers on avoiding grief in the boiler room***

**1.** *Don't let soot and flyash in the back lower chamber pile up until it is between the tubes.* This chokes off draft and causes corrosion on the rear ends of water-leg-boiler tubes and likewise on Aultman & Taylor and B & W cast-iron header units. Soot and flyash gets in tube recesses and cakes due to dampness and wetting down ashes for removal.

**2.** *Don't fail to build up the rear wall under the mud drum on header-type boilers.* This should come above the top of the mud drum in the rear chamber, with a 2-in. space between mud drum and wall. Fill the space with loose asbestos or mineral wool, providing an air-seal expansion joint and a stop to keep ash from attacking mud-drum nipples.

**3.** *Don't remove safety valves for boiler testing.* Blanking-off makes a good job, but there is a good chance of twisting off some of the studs because nuts are "frozen" by heat and rust. Trouble with studs will probably tie up the boiler, besides giving you a nice job of removing the stumps without injuring drum or saddle. The best answer is a safety-valve gag.

**4.** *Don't fail to check bolts of internal drum baffles for tightness.* The circulating action of the water will make them vibrate badly if loose and in time will cut the bolts through.

**5.** *Don't fail to check the brace running from the center of the drum baffles to the internal feed line.* Looseness at this point will soon wreck the pipe threads holding the internal feed line through the drum head.

**6.** *Don't let the internal feed line clog.* This cuts down the feed supply or increases head on the feed pump.

**7.** *Don't monkey with safety-valve settings.* That's the inspector's job.

**8.** *Don't forget to remove floats and whistle, on high-and-low alarm columns, and plug whistle hole during a 50% overload test.* Floats are liable to collapse if left in place.

**9.** *Don't fail to check the elbow and blowoff pipe inside the rear wall, and at bottom of mud drum or water legs.* Being buried and out of sight, these pipes and fittings are often neglected with bad results.

**10.** *Don't neglect to open inspection plates on stoker water backs, at boiler cleaning time.* Remove scale to avoid danger of rapid burnouts.

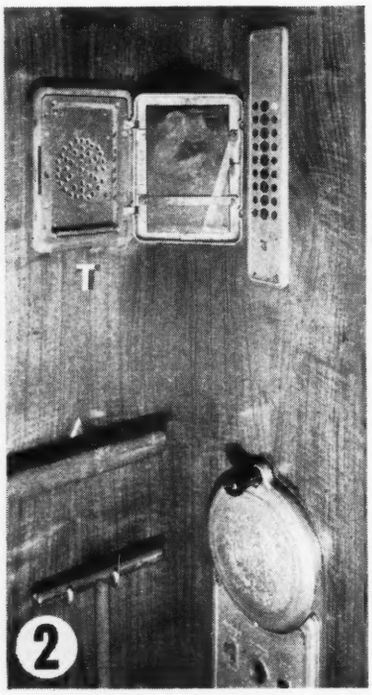
**11.** *Don't fail to remove inspection plugs on water-column piping occasionally to see that piping is clear.*

**12.** *Don't fail to see that brickwork is built up to protect base of front headers.* This protects not only the headers or water-leg bases but also prevents soot-blower elements at front from getting warped and ruined.

**13.** *Don't let dirt and scale lay in recess at bottom of front headers (cast-iron or steel).* A combination of dirty recesses and bad front inside protecting brickwork will soon mean burnt bases and new headers.

**14.** *Don't let gas baffles, whether plastic brick or cast iron and brick, get into disrepair.* In plastic brick baffles, the intense heat will take the path of least resistance through the holes and will warp the tubes. In cast-iron and brick baffles, if the brick is gone the heat will ruin the cast back plates and then warp the tubes; in either case the result is loss of economy, lost baffles and almost certain loss of tubes and time.

# PRACTICAL AIDS TO OPERATION




## Radio Phones on Elevator Cars

FOR QUICK and convenient communication between the central office and the various individuals responsible for elevator service in the 40-Wall-St Bldg, New York City, we installed a system of loud-speaking telephones. Each phone in the system connects to a central desk where an attendant is always on duty and to whom all mechanics report their movements and the starters report all complaints. This system has been highly satisfactory since its installation in 1936, and last year we installed these phones on four important cars so that the operators have direct communication with the attendant at the central desk on the system.

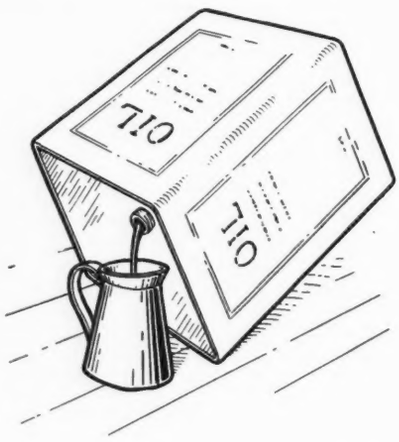
A master low-speaking phone *P* is near the communication attendant, Fig. 1. In each of the four cars we removed the regular telephone and installed in its place a loud-speaking phone and transmitter, as at *T*, Fig. 2. Each loud speaker and transmitter is near the operator, so that he may talk with the central attendant and still be free to operate the elevator. If the operator wishes to talk to the central attendant, he has only to speak in a normal tone and he will be heard. The phones are installed in the cars so that the covers over them do not have to be open when talking. These phones have been in service for about one year and have accomplished all we expected of them.

*New York, N. Y.* WM DEVAUGHN

## Try This One When Emptying an Oil Can

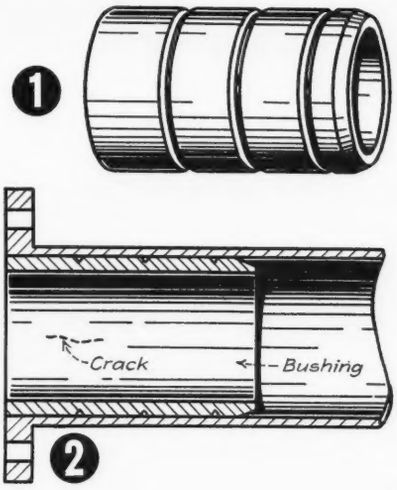
MANY ENGINEERS do not know of the simple little trick shown in figure. I happened to try it and found that it worked much better than holding the can so that the spout is on the bottom corner. Furthermore, you do not have to mutilate the can by punching an air hole in the top corner. In this method, oil flows out the bottom of the spout in a smooth stream while air flows in through the top to prevent surging of the liquid.

*Englewood, N. J.* R BOETTINGER




## High-Pressure Line Repaired with Bushing

A 200-LB COPPER LINE running to a steam whistle cracked near the flange on one end. As pipe was not available to replace this section and we did not have a welding set we looked to other means to get out of our trouble. From a heavy piece of brass stock I turned a bushing with three grooves, see Fig. 1. This bushing was made to have a driving fit into the pipe. After heating the pipe with a blow torch and filling the grooves in the bushing with white lead, it was driven into the pipe. Fig. 2.



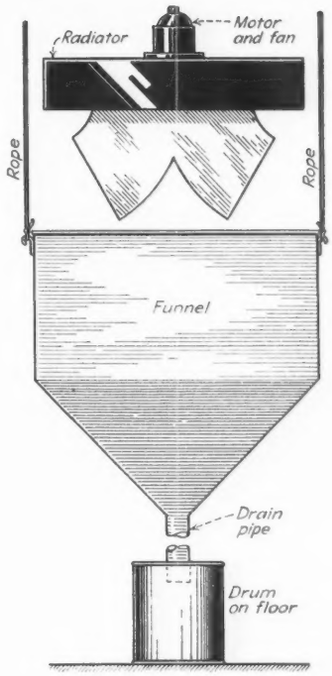

For further support a heavy 2-piece clamp was forged and bolted around the outside of the pipe over the crack. When the pipe cooled it pulled slightly down into grooves of the bushing and made a very tight joint between the two. This joint proved so satisfactory that later, when the pipe could be replaced, it was decided not to make the change.

*New York, N. Y.* S M Elonka

## Quick Cleaning of Unit Heaters

One floor of our factory is heated with 93 ceiling unit heaters. Last winter during the coldest weather it was discovered that some of these heaters were not delivering any air. After two years operation many of the radiators had collected enough greasy dirt and dust to insulate the coils.

High-pressure air was first tried and then steam to clean the heaters, but much of the oily soot remained on the fins and tubes. At last we made a large funnel to be drawn up with ropes to a position under a heater. This funnel was connected by a drain to a drum on the floor, as in the figure. A high-pressure spray gun using a solvent mixed with hot water and compressed air was employed to wash each heater. The funnel caught the drip and only a few minutes of this treatment was required to clean completely the fins and tubes. The solvent was then washed out with clean hot water and the heaters once more performed with their original efficiency.




*Rochester, N. Y.* H P King

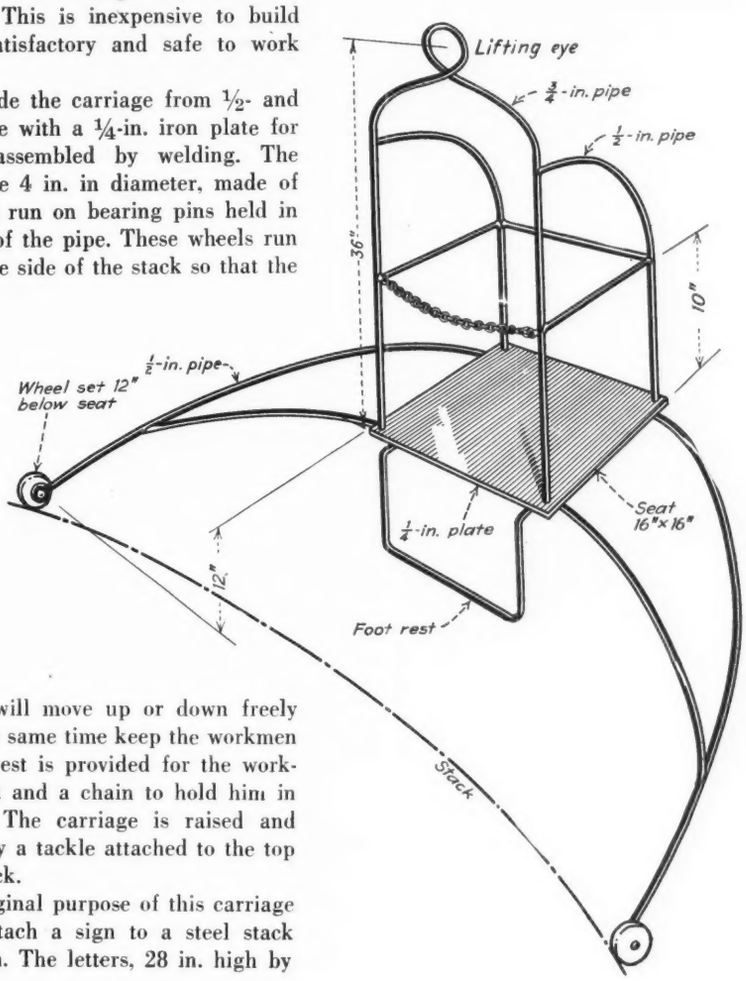
## Carriage Simplifies Working on a Stack

It is frequently necessary to paint, repair, or, as in our case, attach letters to power-plant smoke stacks. These jobs are costly if scaffolding adequate to do the job safely is used. Therefore, we built the carriage shown in the drawing. This is inexpensive to build and is satisfactory and safe to work from.

We made the carriage from ½- and ¾-in. pipe with a ¼-in. iron plate for a seat, assembled by welding. The wheels are 4 in. in diameter, made of wood and run on bearing pins held in the ends of the pipe. These wheels run against the side of the stack so that the carriage will move up or down freely and at the same time keep the workmen clear. A rest is provided for the workmen's feet and a chain to hold him in the seat. The carriage is raised and lowered by a tackle attached to the top of the stack.

The original purpose of this carriage was to attach a sign to a steel stack 75 ft. high. The letters, 28 in. high by 45 in. wide, were made of 14-gage tin and set away from the stack by steel pins, riveted to the letters and welded to the stack.

*Bismarck, N. D.* Leslie Bradley




## Old V-Belts Used for Packing Strips

When small apparatus or equipment parts are to be shipped back to the manufacturer for repair or exchange, proper packing to prevent damage in transit frequently presents a problem. The container must be sufficiently strong to withstand the vicissitudes of shipment and the equipment must be so supported that it will not be damaged from mechanical shock. For the latter I have found that pieces of old V-belts make excellent shock-absorbing pads.

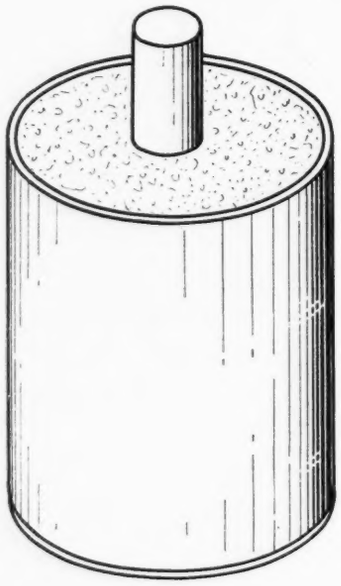
These can be cut into lengths required for the job and securely held in place with small nails. They can be easily bent into almost any shape and are sufficiently thick to permit being notched to take the edges of flanges.

*Clinton, Iowa* Frank Bently

## Maintenance Anvil Rolls to the Job

ON REPAIR JOBS around the plant I found that a good substantial anvil comes in handy, so proceeded to build one that could be moved about easily. To one end of an 18-in. section of 12-in. pipe I welded a steel plate. A section of 4-in. shafting was centered in the pipe, tack-welded to the bottom plate, and the pipe was filled with concrete to give the necessary weight and stability, see figure below. The anvil is easily moved from one place to another, by turning it over on its side and rolling it along.

*Peoria, Ill.* JOHN E HYLER



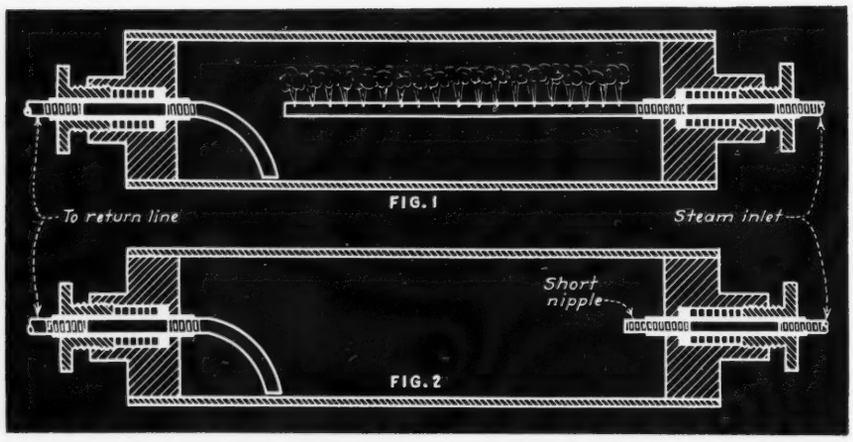



FIG. 1

FIG. 2

## Changed Steam Inlet Increases Heating Rate

WHEN CHANGING THE STEAM CONNECTIONS on a paper-board drying machine the department foreman asked to have the steam pressure increased from 25 to 50 lb to get more effective drying. The machine was designed for 25-lb steam so I decided to try and find the cause of the foreman's complaint. When the steam connection into one of the drying rolls was removed I found that the internal distribution pipe was $\frac{3}{8}$-in. in diameter with $\frac{3}{32}$-in. holes, Fig. 1.

It was evident that these holes were restricting steam flow to the rolls. Further, I could see no reason for the distribution pipe because the rolls were only 42 in. long. Therefore, we decided to replace the pipes with short nipples, Fig. 2. Since the change, the rolls, in starting up, become thoroughly heated in 10 min compared to 45 min.

*Englewood, N. J.* R BOETTINGER

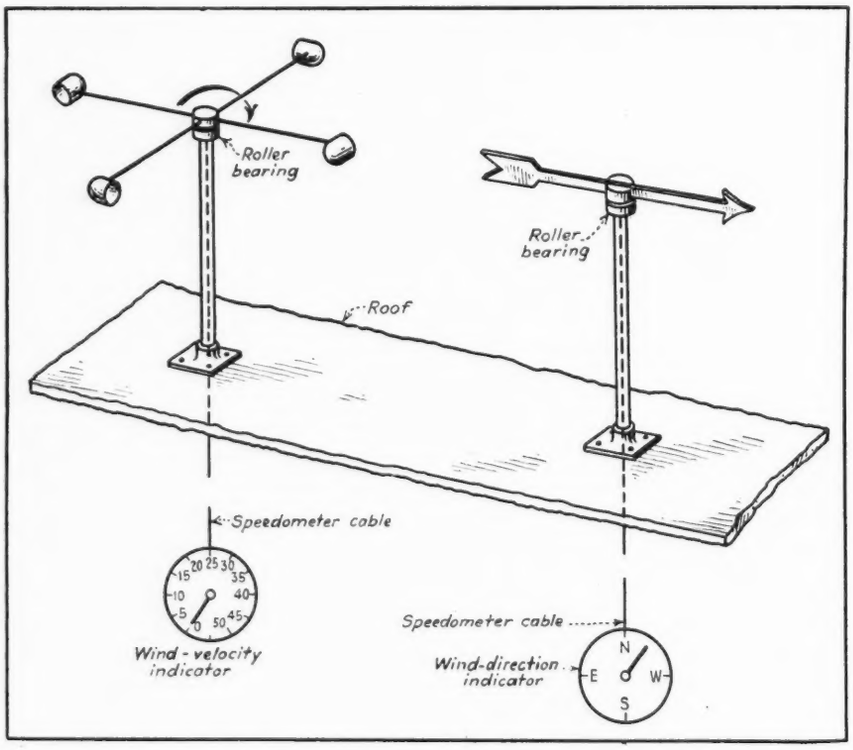
## Weather Bureau On the Spot

WE LONG AGO DISCOVERED what most engineers find out: heating a building depends primarily on outside temperature but wind direction and velocity also play an important part. Outside temperature gets pretty low in winter so that wind is a real factor in heating our plant. We therefore built a wind-direction and velocity indicator from material at hand.

For the transmission and drive equipment we used two automobile speedometers and sufficient flexible shafting to run from the boiler-room meter board to the plant roof. A home-made weather vane, supported in a roller bearing on a roof stand, was connected by flexible shafting to the pointer shaft in one of the speedometers on the meter board. On the face of this speedometer we marked the four points of the compass to give wind direction, see diagram, right.

We made a winding-velocity head from four cups taken from the back of the automobile-horn casings. These we welded to one end of four rods, the other ends of the rods being welded to a hub. This assembly was then mounted in a roller bearing in a stand on the roof and connected by flexible shafting to the other speedometer, shown on the left in the figure. We calibrated this speedometer to indicate wind velocity in miles per hour, as shown on the indicator on the left.

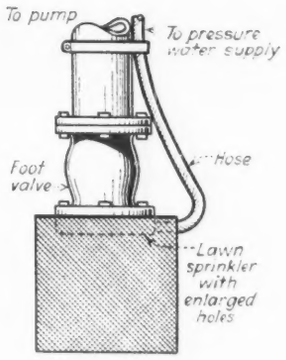
*Rochester, N. Y.* H P KING



## Backwashing Cleans Pump Strainer

WE WERE HAVING TROUBLE with the strainer on a pump suction stopping up frequently. After trying several unsuccessful schemes to keep the strainer clean, we hit upon the idea shown in the figure.

First we made up a large wire-mesh screen that fastened to an iron disk with a hole through its center the size of the suction-pipe intake. Below the disk we attached an ordinary circular lawn sprinkler with a hose connection running up the suction pipe to a valve and pressure-water connection. The holes in the lawn sprinkler were enlarged about three times. Now, once every two or three days we open the valve in the sprinkler line and let water flow back through the strainer for a couple of minutes. This backwashing keeps the strainer clean.



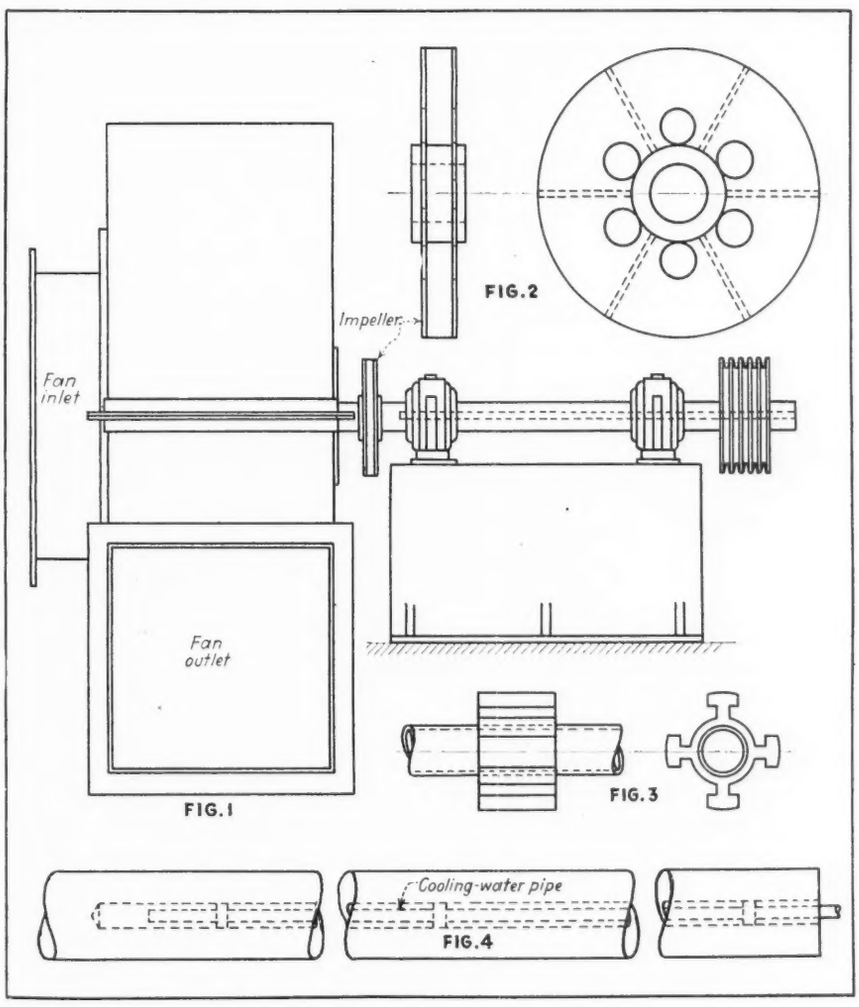

*Richmond, Va.* C R ANDERSON

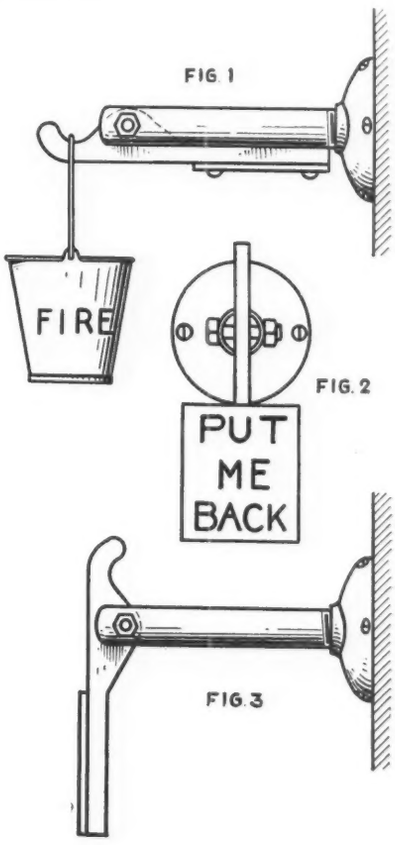
## Keeps 1200 F Away from Fan Bearings

WE HAD THE PROBLEM of cooling the bearings of an induced-draft fan handling blast-furnace gas at a temperature of 1200 F. First, we installed an impeller on the shaft between the fan and bearing, as in Fig. 1, to keep as much heat as possible away from the bearings. This impeller is built up of two copper side plates and six vanes supported on a cast-iron hub, Fig. 2. Holes bored through the side plates, near the hub, acted as inlets to the impeller so that it draws hot air away from along the shaft. Part of the heat flowing along the shaft is also picked up and dissipated by the impeller.

We also bored a hole, in the center of the shaft, extending from the drive end up to near the impeller, Fig. 1. In the center of this hole we rigidly supported a wrought-iron pipe, as in Figs. 3 and 4, and connected it to a gravity-flow water supply. Water flows in through the pipe and out the clearance space between the pipe and shaft bore. This water cools the shaft from the impeller to the drive end. As a further precaution we installed an oversize bearing, with ample cooling-water passages nearest the fan.

*Johannesburg, South Africa* H DOUGHTY




## Fire-Bucket Holder

LEAVING FIRE BUCKETS unfilled is a common, though dangerous, practice. The device shown acts as a reminder to refill the bucket after it has been removed and emptied. The bucket support consists of a piece of slotted pipe screwed into a wall flange. A length of strap iron shaped into a hook at one end is held into the slot by a bolt, Fig. 1. If the bucket is removed from the hook, Fig. 3, the hook takes a vertical position and exposes a sheet-iron flag on which is printed "PUT ME BACK," Fig. 2.

*New York, N. Y.* S M ELONKA

# READERS' PROBLEMS

## *Questions from Our Readers*

### Worn Diesel Piston

#### *Question 1*

ON PULLING A PISTON *of our 4-cycle, 250-rpm, 8-cyl, 1000-hp, mechanical-injection diesel, we found that the piston was worn oval about 0.015 in., on the thrust side, and all the rings were worn in a similar manner. As a matter of fact, the rings were worn to about half their original depth at that point. The liner was in good condition, showing no scores and only normal wear. We installed a new piston and ran for 3 hours. The wrist pin then got hot, causing the piston to score the liner.*

*Pistons are lubricated from an outside lubricator, which was working OK when the scoring occurred. When running the engine now, we hear a noise from that cylinder, which, we assume, is a piston slap, as all the bearings have been checked. This is the second time we have changed a piston and the second time this has happened. The engine is only 11 months old. The pistons were checked before installation and found to be at the required dimensions. Is it good policy to have the old liners rebored and oversize pistons installed? Can some* POWER *reader suggest a cause and remedy for the trouble?*—RRS

### Rain Water for Boiler Feed?

#### *Question 2*

WE ARE LOOKING *for information concerning the advisability of using rain water collected from the roofs of our buildings as feed for our steam boilers. We have both bent- and straight-tube units ranging in size from 3000 to 5000 sq ft heating surface. Roofs are constructed of slate and metal. Rain water is conducted through metal downspouts and then through sewer pipe into underground concrete reservoirs. From this storage we propose to draw water for boiler use. Is there any possibility that such water would not be suitable?*—JW

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

## Two Belts OK?

### *Answers to Aug Question 1*

#### *The Question*

WE HAVE A TROUBLESOME BELT DRIVE *consisting of a 90-in. diameter pulley driving a 20-in. diameter pulley through a 24-in. double leather belt with pulleys on 21-ft centers (approx). To transmit the maximum load of about 135 hp, it is necessary to keep the belt extremely tight, which, we believe, causes the two plies of the belt to come apart continually. One of our operators claims that the difficulty could be overcome by running a second belt outside of the one now in use, keeping the outside belt reasonably tight and the inner belt slack. In theory, the outside belt would make the inner belt grip the pulley better and thus pull most of the load. Would this work satisfactorily?*—JTZ

### Two-Belt Drive

BACK IN 1893 we had a drive from a Buckeye engine under practically the same conditions as described. A 24-in. single leather belt had been in use several years and began to show wear, so we put an old 8-in. double leather belt outside the single one.

This worked for about a year and then one night the single belt broke in operation and, of course, came off. The 8-in. belt remained in place and carried the load without shutdown. Fortunately, no damage was done. Do not try to fasten the belts together as there will be a slight "creep" between them.

*Bloomfield, N. J.* E A EARLE

### Use Idler Pulley

DIFFERENCE IN DIAMETERS of the two pulleys makes it necessary to have the driving belt as tight as possible to transmit the hp required. However, there is a possibility that JTZ has reached that point, bordering on excessive tightness, which causes overheating of the belt, and this overheating, combined with a small diameter of the driven pulley, causes the belt plies to split.

A second belt running atop the main driving belt would not eliminate the trouble and the installation would be too costly. To overcome the difficulty, install a sliding idler pulley, equipped with balance weights as shown in the sketch. This will eliminate much of the trouble. The brackets and other parts may be made out of odds and ends.

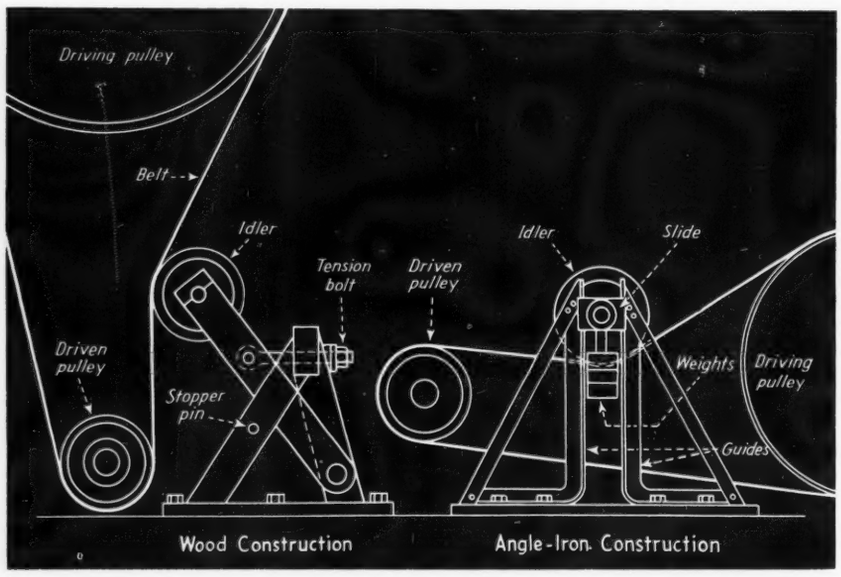
*Grand Rapids, Mich.* J M GORRIE

### Recondition the Belt

THE ANSWER IS "no" to the question of running another belt outside the regular one. Theoretically "yes', and practically also, as the inner belt would grip the pulley better, but inasmuch as the inner belt would be slack and the outer tight, the inner belt would not carry its share of the load and the outer belt would carry more than its share, so the life of the outer belt would be short. There is also the difficulty of running the outer belt properly on the inner.

More information is needed to recommend a remedy but checking some possibilities might cure the trouble. In the first place, the belt speed must be slow to necessitate the excessive tightness. In the second place, the condition of the belt and the conditions under which it runs must be considered. Another important factor is the glue used and the method of application. My guess is that the belt is dryer than usual, has lost its pliability and needs reconditioning, or the glue may be poor and this, with the tightness, is pulling the plies apart.

I recommend that the belt be thoroughly



reconditioned by the following method, after which it should be run more slack so as not to pull apart on the smaller pulley. If the belt is oily, the oil should be removed by using rollers and powdered chalk to absorb it. Another method would be to pack in sawdust for at least two days, preferably more, and then clean.

In gluing, the surfaces should be scraped with a slicker and a thin coat of sizing applied. Put the cement on rapidly, bring the surfaces together and hammer all over with a shoemaker's hammer. The belt should be clamped tight all over, as much as possible, using rubber-faced shoes or boards, and allowed to set for about an hour before removing clamps. Added use of shoemakers' nails will strengthen the cement, possibly by the amount needed in this case.

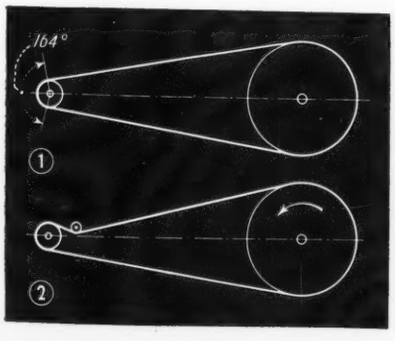
After cleaning and re-cementing, the belt should be given its necessary pliability and a clean pulling surface by restoring the natural oil a new belt contains. Use a good belt grease for this purpose. Belt dressing should be used only in emergencies. However, a belt should be scraped clean and greased about once every 6 months.

A good belt cement can be made by mixing Le Pages liquid fish glue and Russian liquid isinglass in the proportions of 2 to 1, by measure. Apply rather hot. If cementing is done in a cold room, warm the belt by passing burning paper back and forth over it. A serviceable grease can be made by mixing 2 parts of pure beef tallow (by weight) and 1 part cod-liver oil. Melt tallow, allow to cool until it won't burn the finger, then add cod-liver oil and stir mixture until cold.

*Shiprock, N. M.* J F MAHER

## Belt Tightness Not Answer

IN BELT DRIVES, especially with flat belts on crown pulleys, tightness alone will not cure tendency to slip. In JTZ's case, it is impossible to tell if the belt is wide enough to transmit the horsepower because he does not give pulley rpm or belt speed in feet per min. From the data given, assuming that the belt is the right




size, we can find the arc of contact on the smaller pulley, which seems to be the cause of the trouble. This is considerably less than 180 degrees (see sketch).

More benefit can be derived by increasing this arc of contact than by installing another belt to run over the present one. This can be done by increasing belt length slightly and installing an idler pulley to increase contact. The drive could also be arranged so that the slack side of the belt runs on the top instead of the bottom, as this also tends to increase contact (see sketch).

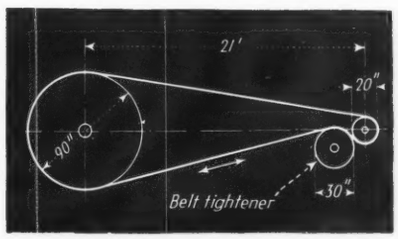
Running a belt over the present one may prove difficult as the impression of the pulley crowns may not affect the second belt enough to keep it in place. If the belt continues to slip after contact has been increased, studies should be made to determine if the belt is of the proper width or if the speed is too high.

Considerable flexing of the belt takes place as it passes through stages of compression and tension and this may cause the plies to separate. Running the bet too tight will aggravate this trouble and will place a heavier load on the shaft bearings.

*Conestoga, Pa.* E W FELLER

## Temperature Difference

JTZ's TROUBLE comes from the difference in temperature and tension between the lower and the upper ply, while the cement between them acts as an insulating layer. Although a belt drive with a distance of 21 ft between pulley centers doesn't require a belt tightener, in this case such a contrivance will compensate the difference between plies and so cure the trouble. The pulley of the tightener should be situated near the small pulley, in the track line




(see sketch). It should have a diameter of 30-35 in. A second belt outside the one now in use will cause slipping and flapping.

*Vancouver, B. C.* ALEXANDER KAPLAN

## Try Rubber Belt

I BELIEVE JTZ would only aggravate his trouble by placing a second belt outside the existing belt. This belt may have become too oily or greasy from belt dressing, or due to slippage the belt may have become too hot and caused the glue to loosen. Oil or grease penetrating the belt might have the same effect.

As JTZ does not state the exact conditions under which the belt runs, it is hard to make a definite recommendation. However, I suggest trying a good heavy-duty rubber belt.

*Humboldt, Sask.* T L PATTERSON

## Suggests V-Belts

TROUBLE IS OFTEN FOUND when stepping up speed in power transmission. Even where a 1-2 ratio is used, slippage and decreased belt life will be noticeable. And where a 1-4.5 ratio is used, excessive tension must be applied to any flat belt to attain a reasonable horsepower transfer. The great diameter of the larger pulley shortens the contact arc on the smaller, while the short center distance plus high belt tension does not let the belt increase contact by sagging.

Using an outer belt is not good mechanical practice. I suggest that the flat belt be replaced by a multiple V-belt drive, using a new grooved 20-in. pulley and allowing the V-belts to gangle over the larger one. There is ample contact arc there and gangling over the flat pulley will not damage the V-belts in any way.

*Marissa, Ill.* GEORGE BLUM

## Use Triple-Ply Belt

INSTALLATION OF A SECOND BELT as described will relieve tension on the existing belt provided the drive is horizontal and the tight side of the belt is on the bottom. If the tight side is on top, the shorter belt will have to be installed next to the pulleys. However, there are a number of objectionable features to this method and better operating conditions will result from using one triple-ply belt. In one of the first power plants operated in this city, a drive pulley was operated with four belts. The chief engineer claimed that constant care was required to maintain correct tension adjustment to prevent slack sides of belts from striking one another. Also, the additional belts simply multiplied wear, cleaning of leather surface, and power lost by creepage.

Belt speed is not mentioned, but a survey of pulley diameters, shaft centers, and contact arcs indicates that if properly installed and operated under favorable conditions, a 24-in. regular double leather belt with cemented splices will transmit 250 hp at 4500 fpm, without undue strain. Hence, it is evident that one or more unknown and severe operating conditions exist and it would be wise to determine if correction is possible before investing in more belting.

It should be remembered that leather belts will give many years of satisfactory service if they are not abused. Vertical drives, horizontal drives with tight side of belt on top, slow speeds, high speeds which tend to throw the belt off the pulley by centrifugal force, stalling of machines, sudden load application, grime, grease and moisture on belt and pulley, all tend to increase belt tension. When such conditions cannot be avoided, it is necessary to provide a belt of sufficient proportions to take the strain without pulling apart.

*Fresno, Calif.* E H CARLSON

## Airbound Water Line

### *Answers to Aug Question 2*

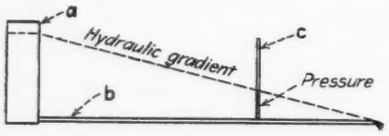
### *The Question*

A 2-IN. PIPE *about 1000 ft long supplies our plant with water for drinking and for washing out boilers. After washing out a boiler, the line often becomes airbound and it takes some time to reestablish flow. The source is a small reservoir kept filled by a spring which is about 50 ft higher*

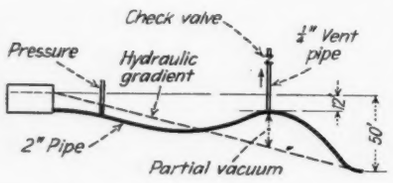
*than the boiler house floor. There is a crest in the pipeline about 12 ft lower than the water level in the reservoir. What causes the pipe line to become airbound and how can we cure it?*—PSW

## Answer Lies in Hydraulic Gradient

THE PRINCIPLE of the hydraulic gradient will explain PSW's trouble with an airbound pipeline. The sketch illustrates this principle; the standpipe at *a* is filled with water and a pipeline *b* runs out from the standpipe. The straight line running from the standpipe water level to the open end of the pipe is called the *hydraulic gradient.* The pressure at any point in the pipe, when water is flowing, is represented by a glass tube as at *c*, because water will rise in the tube to the height of the gradient line.



Ideal Case



Actual Case

The second part of the sketch illustrates PSW's case, as reconstructed from his description. This shows the hydraulic gradient and wherever the pipeline runs higher than the hydraulic gradient, the pressure changes to a partial vacuum. This, of course, occurs only when water is flowing. Because of this vacuum, air enters the pipeline, either through leaks or through the open end of the hose, although this is improbable. Air leaks in a line of this length are quite common, but uncommonly hard to find. If they can be located, they should be repaired and the trouble will vanish.

If the leaks cannot be located, or if air comes from the hose end, place a vent pipe at the crest of the line. A ¾-in. pipe will be large enough. The upper end should have a check valve to prevent entrance of air, but permit air to escape quickly when the water is turned off. The vent should be higher than the water level in the reservoir, to prevent loss of water when there is no flow in the 2-in. line. The writer has seen this same condition on the suction line of a centrifugal pump and the trouble was cured by a vent pipe as described.

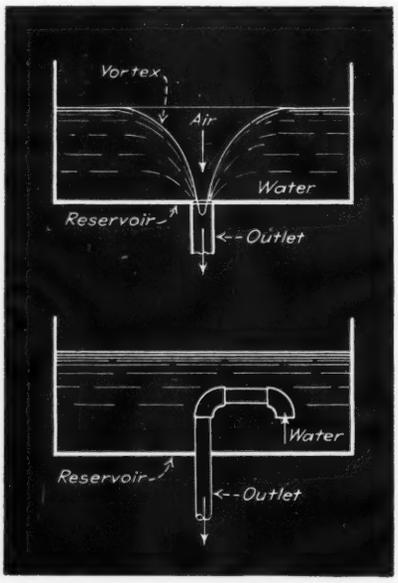
*Asheville, N. C.* R K ANNIS

## Blames Air in Solution

THE FAILURE OF WATER SUPPLY described by PSW is no doubt due to the "crest" or siphon in the piping. Such arrangements are sometimes used in lines to avoid excessive excavation, but they are always provided with air vents. Water under atmospheric pressure carries about 2% of air in solution; this quantity increases as pressure increases, and decreases as temperature rises.

If a pipe is filled with water from a river or pond, both ends closed and the pipe stood on end, it will be found that air has collected in the top of the pipe. Also, under the conditions described by PSW, the water flowing through the downstream leg of the siphon acts as a piston, creating a partial vacuum in the highest point of the piping, thereby liberating a portion of its air. The so-called crest being only 12 ft below the reservoir water level, makes it a simple matter to install a small pipe, say ¾-in., in the crest, with its upper end open and slightly above the water in the reservoir. This will vent the air and cure the difficulty.

*Los Angeles, Calif.* C O SANDSTROM




## Vortex in Reservoir

LOW WATER and the whirlpool action set up in the reservoir by withdrawing large quantities of water causes PSW's line to become airbound. The action is the same as when water is allowed to run out of a bathtub or washbowl. The easiest way to stop the trouble would be to run the pipe about 18 in. above the reservoir bottom and put on two ells so water will flow into the pipe from the bottom.

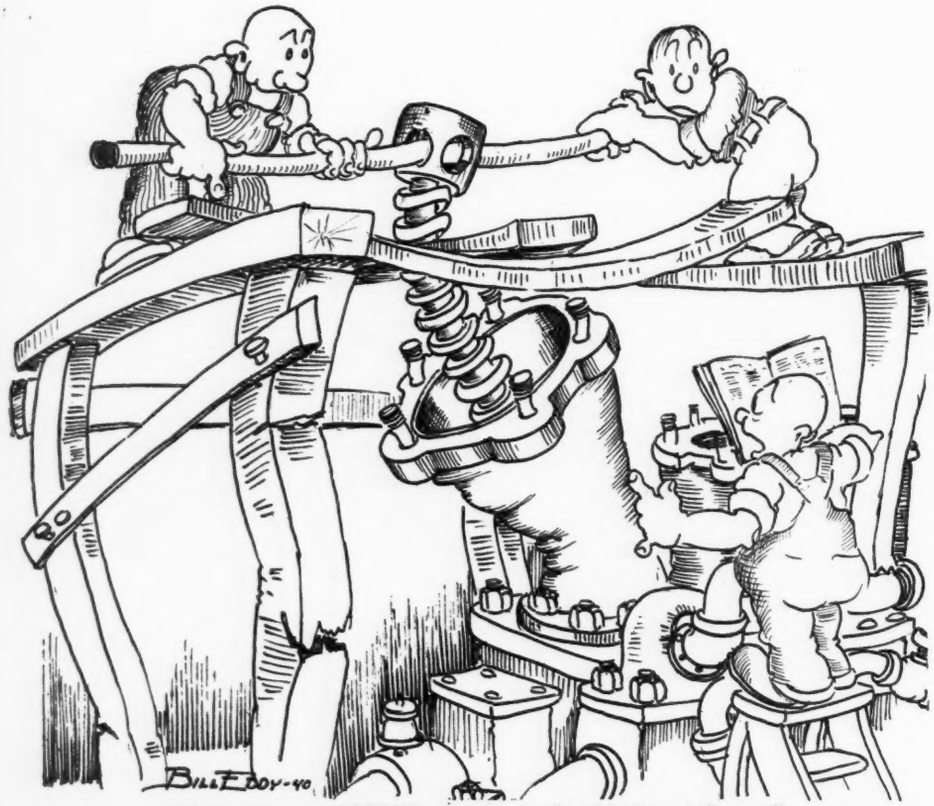
*Chicago, Ill.* H D BROWN

## No Trouble at Small Flow

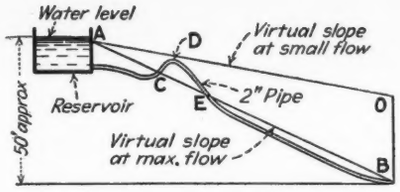
AS SHOWN IN THE SKETCH, when the valve at *B* is opened full, the available head (height of *A* over *B*) practically all goes to overcoming pipe friction. The *hydraulic gradient* or *virtual slope* for maximum flow will be a straight line from *A* to *B*. The pressure inside the pipe at any point will be the vertical distance from the pipe to the virtual slope. The diagram shows that pipe *CDE* with the crest *D* has a negative pressure. This means that, under maximum flow conditions, pressure in length *CDE* is less than atmospheric and this will tend to draw air in through leaks. This is probably what happens when washing out a boiler.

When flow is small, pressure in the pipeline will rise and the virtual slope will be above *D*. In this case, no part of the line has less than atmospheric pressure and there will be no air binding. The drop *OB* in this case will be the pressure loss across the partly opened valve at *B*. When there is no flow, the virtual slope is a horizontal line drawn from *A*.

▲ ▲ ▲



**"According to POWER, the liner should slip right out"**




The best cure for this trouble would be to lower the crest until it is below the virtual slope. In case the crest cannot be conveniently lowered, an air vent valve installed at *D* would allow air to escape and so permit the pipe to fill with water immediately after using. Standard valves with ball floats are made for this purpose.

*Sault Ste Marie, Ont.* JOHN HARDIE

## Automatic Air Valve

A 2-IN. PIPE, 1000 ft long, with 50 ft head, won't carry much water at best, and if scaled up inside, much less. If the crest is near the boiler house and some distance from the reservoir, it might be that water runs out the short end of the line, under 38 ft head below the crest, faster than it can run into the pipe from the reservoir. This causes a vacuum at the crest and the resulting air lock.

If it isn't possible to get the pipe on a level through the crest, put an automatic air valve on the highest point in the line or use a riser vent. Air can escape in either case. The only objection to this plan is that it would kill the downhill pull from the short end of the line which helps the flow when it isn't over the line's capacity.

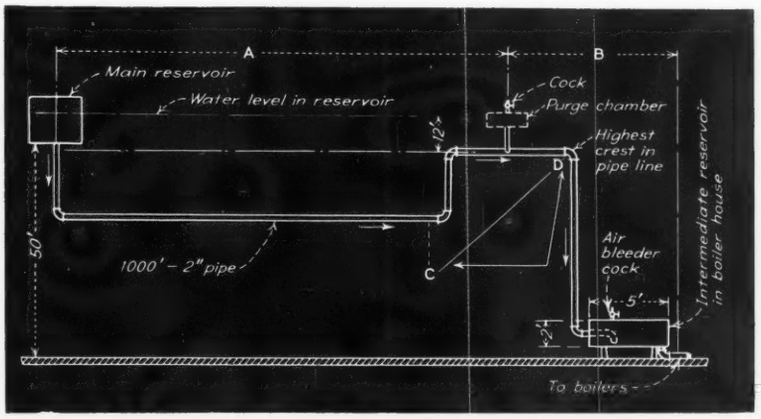
*Carlsbad, N. M.* E A ROBERTS

## Use Larger Pipe

THE FIRST TWO sections of the sketch show the general idea of the hydraulic gradient and its application to this case; it may be defined as an imaginary line across the tops of open water columns placed at intervals along the pipe. The negative pressure in the part of the line above the hydraulic gradient is what causes the trouble.

The third section of the sketch shows a suggestion for correcting the trouble by substituting a larger pipe for the 2-in. line from the reservoir to the crest. This will reduce the velocity and maintain a higher pressure up to the crest which will have the same effect as moving the reservoir up to the crest. The sketch shows how this will keep the hydraulic gradient above the line, insuring a positive pressure at all points. If this is too costly, it might be possible to reduce the 2-in. line to 1-in. from the crest to the plant, without decreasing the delivery below a satisfactory point.

*Conestoga, Pa.* E W FELLER




## Eliminate Crest

ALTHOUGH PSW FAILS TO STATE the type of main reservoir, I assume it is open, fed directly from a spring by an open discharge pipe. There is every reason to believe that air in the 2-in. supply pipe comes from this source. It is also possible that an appreciable amount of air can find its way into the line by infiltration, arising from the siphonic action caused by the crest.

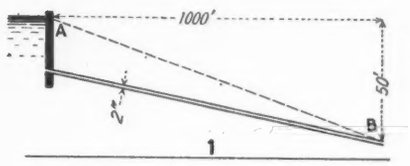
Undoubtedly the crest is somewhere near the boiler house so that the amount of resistance to water flow is greater between the reservoir and the crest than between the crest and the boiler house. In other words, resistance of *A* in the sketch is obviously greater than that of *B*. In boiler washing, the flow of water in the 2-in. line will be maximum and air entrapped and absorbed by water in the reservoir will be pulled into the line by the suction. After some time has elapsed, a considerable quantity of air-impregnated water will have found its way into the line.

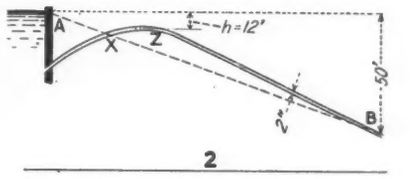
Because of the difference in resistance offered by sections *A* and *B*, the water in the *B* side of the circuit will tend to flow more freely than that in *A*. This produces a siphoning action resulting in separation of some of the air in the water, which is entrapped in the crest part of the line. Fittings, valves, and sharp bends in the piping increase air entrapping. After boiler washing is finished and flow ceases, the air separated from the water stays trapped between *C* and *D* with no chance of escape. Inasmuch as the hydrostatic pressure due to head in this part of the circuit is small, the air will not be reabsorbed by the water for some time. This is the reason why the supply line is air bound.

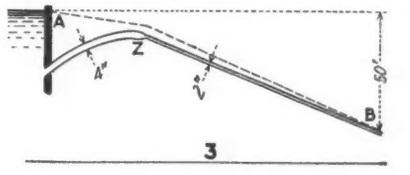
PSW would not have this trouble if the crest in the line had been eliminated when the line was installed. The obvious remedy is to eliminate the crest now, and to carry the line to the point of use as straight as possible, avoiding any connections which might cause siphoning. If the crest was put in to meet a need for a water outlet at that point, such a connection could be made with a vertical riser from the newly laid line.

If PSW can't eliminate the crest, his trouble can be remedied to an appreciable extent by installing an intermediate reservoir in the boiler house (24 in. dia x 5 ft) to eliminate sudden disturbances to flow caused by opening the main supply valve for cleaning operations. This reservoir should be equipped with a bleeder valve to purge any air which may separate from the water and collect in the reservoir. In addition, an air bleeder should be installed at the highest point of the crest. This bleeder should preferably be connected to a small air chamber. The bleeder cock should be opened periodically by hand or purging can be made automatic by putting in a trap constructed for this kind of service.

*Cleveland, Ohio* A R CIOTTI




## Keep Air Out of Line

AIR IN THE LINE must come from (1) draining the reservoir completely, (2) draining the discharge leg from crest to discharge point, as would be the case with a wide open discharge valve and an obstruction between reservoir and crest, (3) a leak near the crest, or (4) dissolved air in the water. This dissolved air could be pulled out by a partial vacuum formed in the line as a result of opening the discharge valve when there is a restriction ahead of the crest. The air lock can be cured by pumping air out of the crest or by pumping the pipe contents out through the discharge end fast enough to sweep the air along with the water.

To prevent future air locks, I would

*(Continued on page 160)*

# HOW TO STRIKE AN ARC AND RUN A BEAD

*(Prepared with the cooperation of the Lincoln Electric Company. Photos posed by* POWER *in Lincoln's New York demonstration room)*

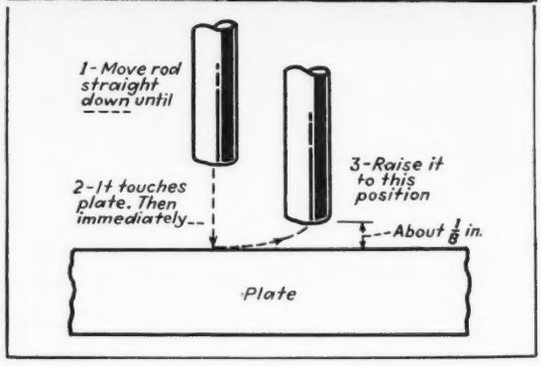
► BEFORE STARTING this first exercise in electric-arc welding it is necessary to become familiar with the setting of the control dials of the welding machine used, or have them set for you by an experienced operator.

*SAFETY.* Following precautions are important: Never look at arc, even for an instant, except through special-formula dark glass of the hood. Protect self and clothing with gloves, hood and overalls or leather apron. Don't lay live electrode or holder on metal work-table. (Hold in hand, hang on insulated hook, or stop machine.)

**1** With welding machine shut off, clamp ground terminal* of machine to steel table used as support for work. Insert end of electrode (3/32-in. "coated" rod) in jaws of holder connected to other terminal. Lay a piece of scrap mild-steel plate on table

* Electrode package sticker states whether electrode terminal should be positive or negative

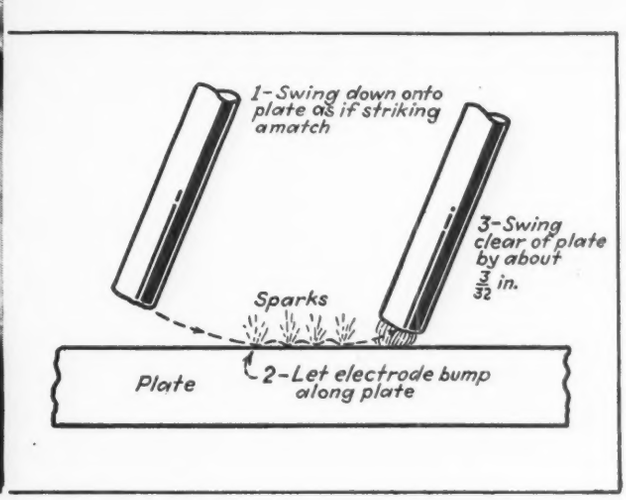
**2** See that neither electrode nor holder is touching plate or table or other metal connected to ground terminal of machine. Then switch on the welding machine. Hold rod vertically or nearly so, over plate about ½-in. above it



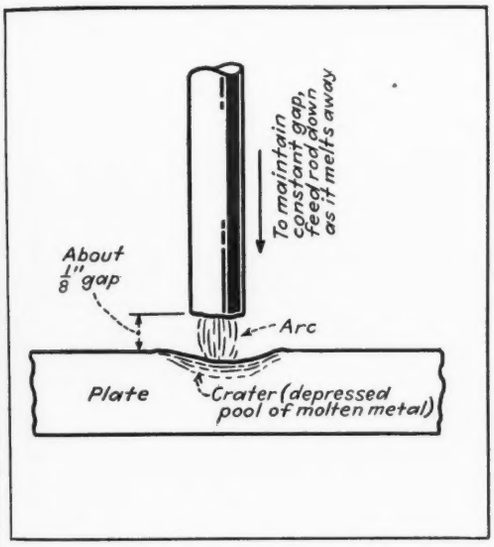

**3** Nod head to drop welding hood over face. Strike an arc by touching rod to plate and immediately raising it about ⅛ in., as shown in sketch above. If properly executed this will give a steady, intense arc above a "crater" (small pool of molten metal on plate). After touching, rod may be raised vertically, or with a slight side sweep as shown in sketch. To strike and *hold* an arc will require practice. At first you will encounter two difficulties

*Freezing.* Rod will "freeze" to work if not withdrawn quickly enough. Break it free at once with a quick twist of the wrist. If this does not free the rod, cut the current by shutting down machine or unclamping rod from holder. Otherwise rod will get white-hot and melt away

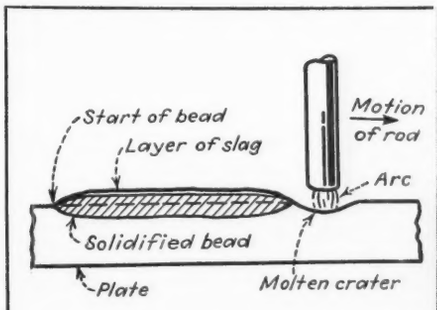
*Arc Breaks.* On the other hand, if the rod is lifted too high after striking arc, the arc will immediately go out and must be struck again


1-Swing down onto plate as if striking a match
3-Swing clear of plate by about 3/32 in.
Sparks
2-Let electrode bump along plate
Plate

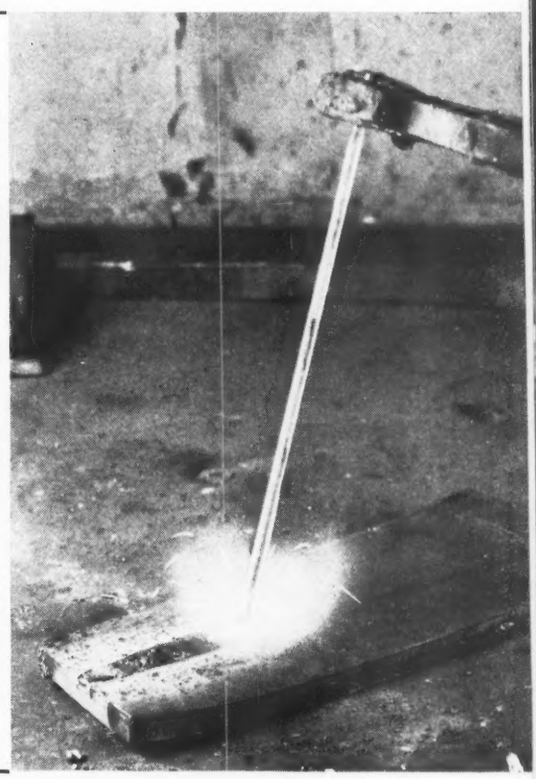
**4** As an easier alternative method of striking an arc, "scratch" the plate with the rod as you would strike a match, ending with a slight upward sweep as shown in photo and sketch




**5** After a steady arc is started, push the rod down gradually as it melts away, so as to maintain a constant small gap between rod tip and the "crater" or pool of molten metal. In general an ⅛ in. gap will be about right, as indicated by a continuous "cracking" sound.

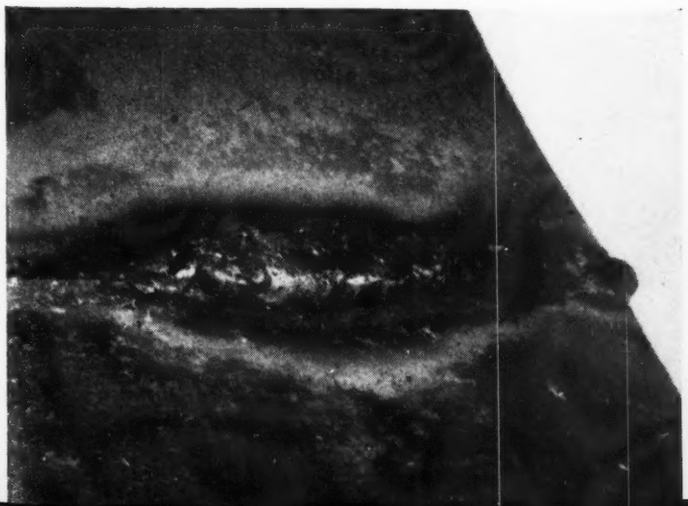



**6** Having developed ability to strike an arc and hold it steady, try running a "bead" on the plate. Hold rod nearly vertical and move it very slowly in a straight line along the surface of the plate. Keep the tip of the rod about ⅛ in. above plate so there is a steady "cracking" sound. Don't move so fast that rod gets ahead of the molten pool of metal in the crater. Move slowly enough to allow molten crater to fill up with deposited metal. (See sketch)



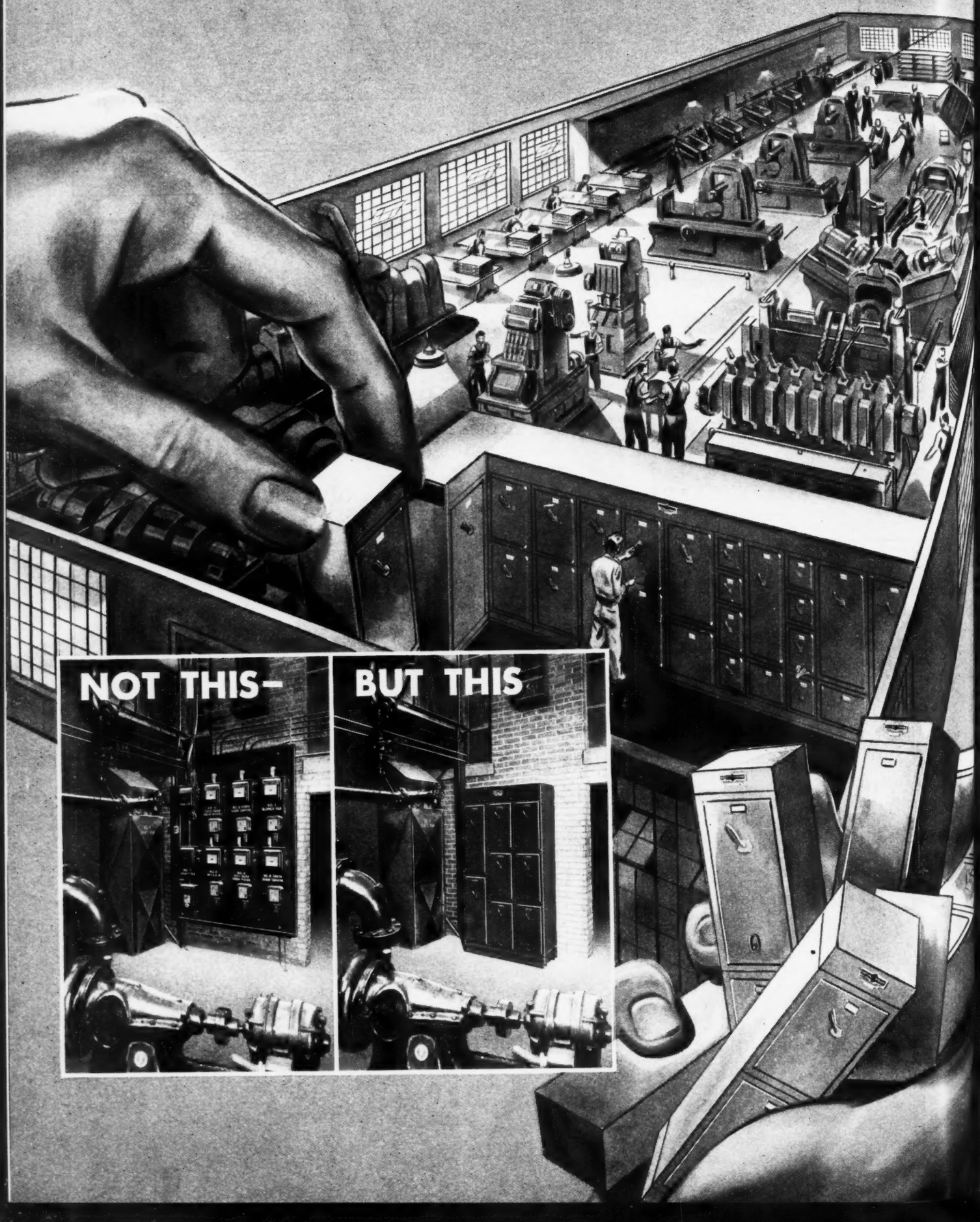
*Note:—This "How To" section in November* POWER *will show how to make a simple butt weld*

**7** The first bead of the amateur welder will probably look like this



**8** Practice running beads until the finished job looks like this. Then section it with a saw and examine the section for defects, (holes, lack of fusion, lack of penetration, porosity)

# NEWS..AN IMPORTA



# NT ANNOUNCEMENT

## *to All Users of Motor Control*

## CUTLER-HAMMER LEADS AGAIN . . . TO MARK ANOTHER MILESTONE OF ENGINEERING PROGRESS UNITROL

TRADE MARK

### UNITROL
### Sectionalized Motor Control

Unitrol is a new idea in Motor Control. It is a new unit type of standardized Motor Control construction which permits all needed types of control devices to be easily organized into a complete enclosed sectionalized Motor Control Center . . . making it just as big or just as small as your present needs require. It is easily, quickly and economically built up, without special engineering, containing just the individual controllers, disconnect switches, and accessories you specify.

Unitrol comes to you complete . . . either with all wiring, busses, supports, terminals and interconnections already made . . . or with provisions for wiring it "on the job". It may be changed, extended, or contracted later on, just as easily and economically as it was first built up. It saves space, time, trouble, worry, and inconvenience up and down the line; and its installed cost is less than the cost of any "home-made" substitute.

### 1st . . . The Unitrol Unit

The basic element of Unitrol is a simple unit mounting-frame into which any standard control device may be bolted. This unit frame has integral with it a hinged cover or door which may be blank, or arranged for either dead-front manual or push-button operation of the device enclosed.

### 2nd . . . The Unitrol Section

The Unitrol Section is a steel enclosure which houses and supports a group of Unitrol Units. It is constructed of standardized interchangeable members to form the sides, top and back . . . with unique provisions for bus supports, wiring troughs, conduit or duct entrances, etc.

### 3rd . . . The Unitrol Control Center

A Unitrol Control Center consists of a grouping of Unitrol Sections fabricated into a complete sectionalized assembly and delivered ready for installation and use.

### Unitrol . . . Fits control to the job

Unitrol permits your control installation to be shaped at will . . . in a straight line, an L-shape, or a U-shape in which case it literally forms its own control room. In some instances, controls may be mounted back to back in the same section . . . resulting in a space economy hitherto undreamed of! And the individual control unit with its door frame forms a brand new time, cost, and trouble-saving "built-in" control for builders of motorized machines.

### UNITROL
### Solves many problems

**DESIRABLE.** Unitrol brings to your control all the simplicity and flexibility of the modern filing cabinet idea. It offers standardized uniformity, appearance and economy. It is *the* control of tomorrow . . . ready for *today!*

**ADAPTABLE.** Unitrol is a boon to builders. Its *known* dimensions and predictable costs permit intelligent planning, with no fuss or worry about placement of conduits in concrete. Unitrol fits right into the job, and can be revamped, changed or extended later with ease.

**LOW COST.** With Unitrol, there is no supporting structure to fabricate; no floor or wall preparation; no special engineering. Unitrol saves space and building alterations! One recent Unitrol installation put 132 motor starters into the same space which could not accommodate more than 50 conventional starters of the same rating.

### Write for this book

A new book . . . "Unitrol . . . the next step forward in Motor Control," tells the whole important story. Gives full description of Unitrol, its many uses and amazing advantages, its construction and specifications. Profusely illustrated. Sent free by request on your business letterhead. Write for *your* copy today. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1358 St. Paul Avenue, Milwaukee, Wisconsin.

CUTLER-HAMMER
UNITROL
C-H

Copr. 1940—Cutler-Hammer, Inc.

**THE MODERN SECTIONALIZED CONTROL CENTER**

# Cylinder Lubrication With Superheated Steam

***William G Forbes, lubrication engineer, Tidewater Associated Oil Co, discusses the factors influencing lubrication of steam-engine cylinders and suggests kind of lubricants to use***

▶ To EXPLAIN engine cylinder lubrication under conditions of superheated steam it is helpful to draw conclusions from lubricating-oil behavior in the cylinders of other types of engines. By following this procedure, factors which are often difficult to understand in engines operating on superheated steam can be logically assumed through these comparisons.

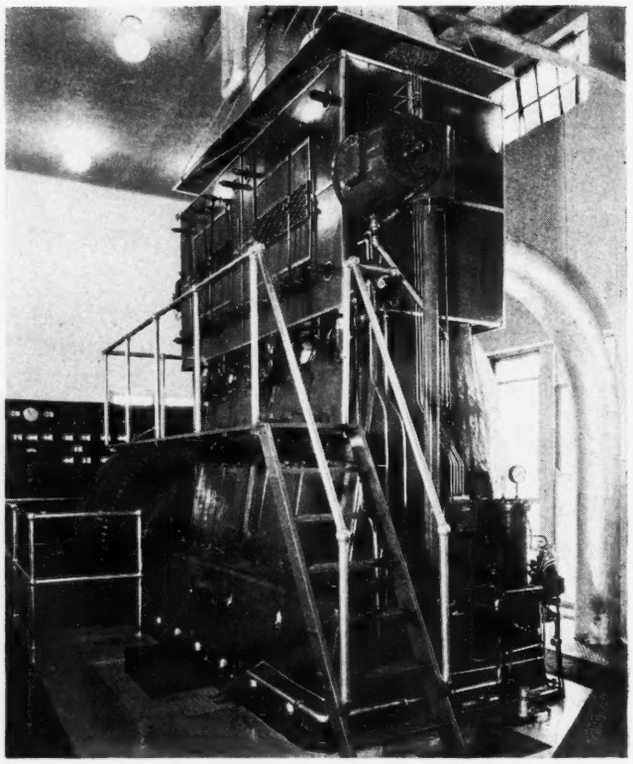
For example, in the cylinders of any internal-combustion engine, over-all temperatures of burning and expanding gases are much higher than those in steam engines. In gasoline and diesel engines the initial temperature of combustion is approximately 3000 F, while that of the exhaust is approximately 750 to 850 F, sufficient to vaporize and destroy the heaviest-bodied oils made. Yet there is very little difficulty in lubricating the cylinders of internal-combustion engines with light-bodied oils. Few engines of this type require lubricants comparable in body to steam-cylinder oils.

In cylinders of gasoline and diesel engines, stationary, marine and automotive, lubricating oil is spread over a water-cooled surface. Hence, an oil film of microscopic thickness survives these high temperatures, because of being on a comparatively cool surface. Experiments show that the average surface temperature on the cylinder walls of internal-combustion engines is about 300 F. Even if the temperature is 350 F in the combustion section of the cylinder, it is still comparatively cool where the lubricating oil is being replenished at each stroke of the piston.

### *Operation of Steam-Engine Cylinder*

Operation of a steam-engine cylinder is just the opposite to that of an internal-combustion-engine cylinder. Instead of the cylinder walls being cooled, they are insulated against heat losses, and very often equipped with steam jackets to maintain the highest possible operating temperature on the internal surfaces. Hence, steam cylinder walls are maintained at higher temperatures than those of internal-combustion engines. For wet-steam operation, these temperatures can be handled with comparative ease by heavy-bodied oils of the type known collectively as "cylinder stocks."

For example, when boiler pressure is 350 lb, corresponding steam temperature is 436 F and the cylinder wall will probably have an average temperature of 350 F. Even with 1000-lb g boiler pressure, initial steam temperature at the throttle valve is only 547 F if there is no heat losses during transit of the steam. However, steam-engine cylinder-wall temperatures are higher than those in an internal-combustion engine, and when the steam is superheated lubrication becomes a problem.



**Vertical engine, operating on 225-lb steam with 100-F superheat, drives 1563-kva, 0.80-pf generator at 257 rpm**

Nature has placed a limit on the temperatures which an oil can withstand. At 500 to 600 F steam-cylinder oils will commence to "crack" and give off volatile vapors, very little from a good average grade, but nevertheless at these temperatures the flash point is reached. This matter is important in lubricating engines using superheated steam. The flash and fire points are of academic interest only, but they assist in predicting the behavior of oil films on cylinder walls where the steam temperature goes above 550 F.

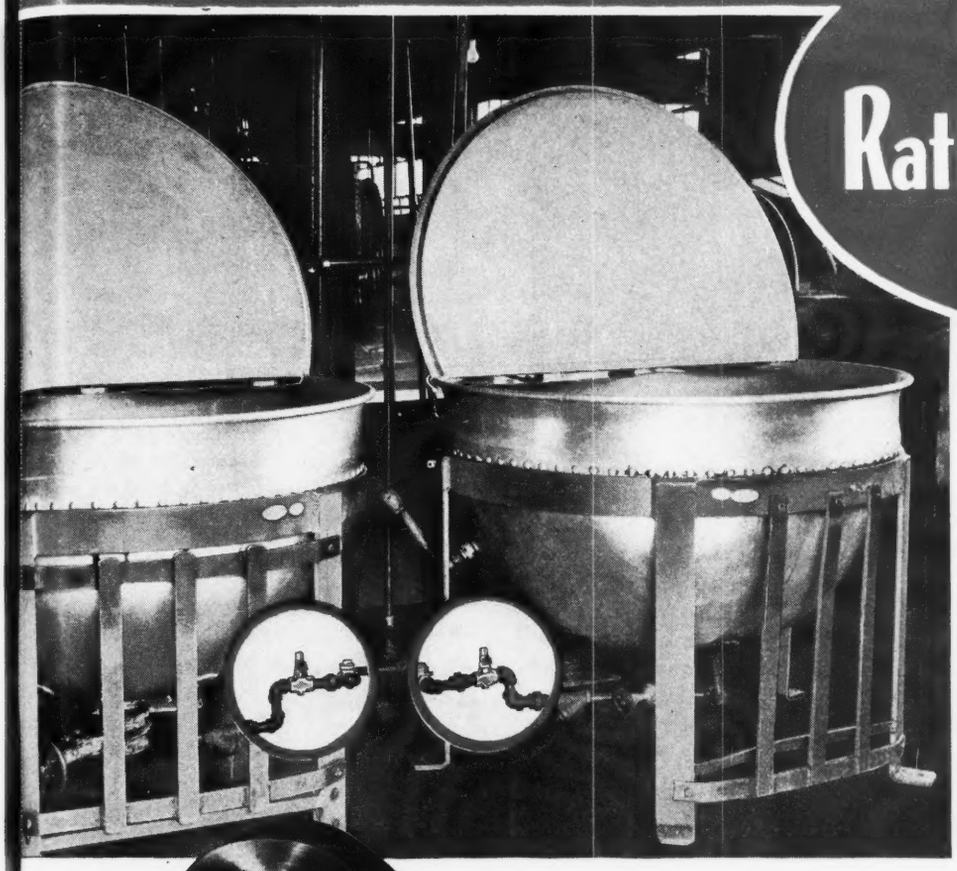
Steam cylinder oils have a closed flash point of 525 to 600 F and a fire test of 575 to 650 F. Hence, we can assume that at these temperatures all steam cylinder oils have reached their limit of resistance to heat in so far as stability is concerned, and the oil films will commence to carbonize.

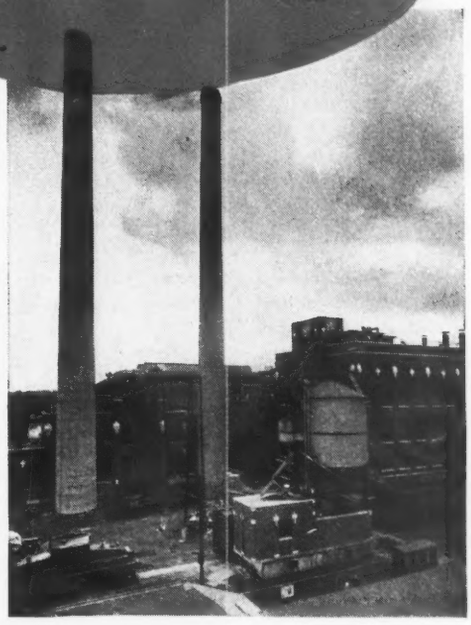
Also remember that all lubricating oils tend to reach a common viscosity or body as the temperature rises. For example, when a light motor oil is heated to 500 F, it is not much thinner than a heavy cylinder oil at the same temperature. They approach a common viscosity and the difference in body, so noticeable at room temperature, is no longer apparent at high temperature.

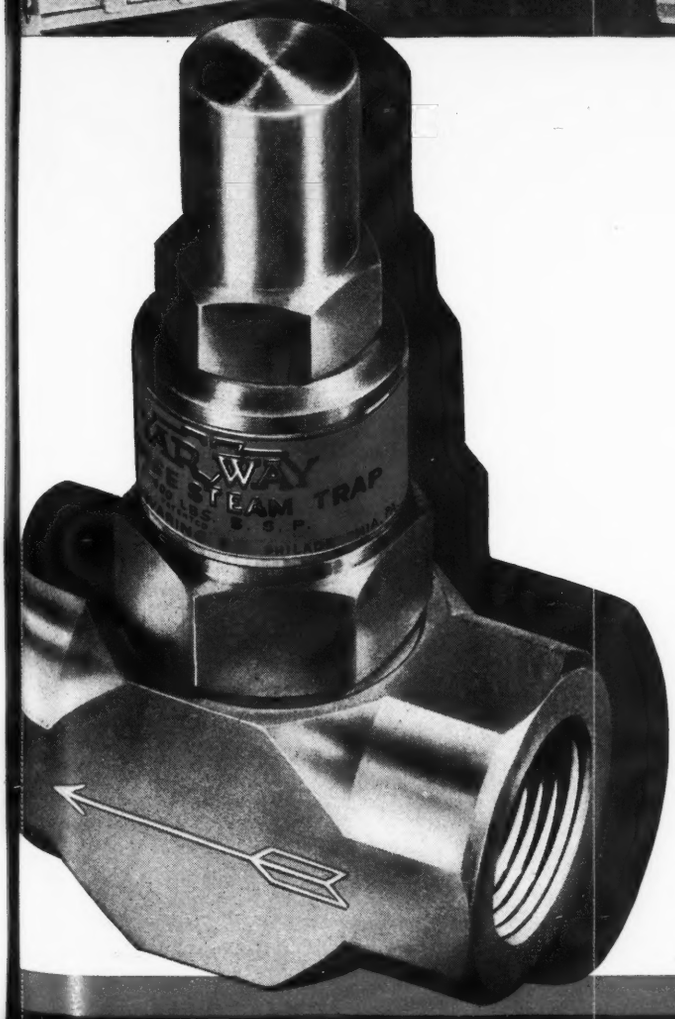
Steam that contains 50 to 100 F of superheat should not

*(Continued on page 116)*

# Over Four Hundred Yarway Impulse Traps SERVE Rath Packing Co.








FOR five years, the Rath Packing Company, Waterloo, Iowa, have used Yarway Impulse Steam Traps in their smoke houses, on unit heaters, on coil and pipe drains, on cooking or processing kettles (as shown above), and for various other services throughout their vast plant.

The fact that the number of Yarway Impulse Traps put to work by this company has grown from a few trial units to several hundred during the past 5 years is testimony to the satisfaction that these efficient little traps have given on the job.

You can solve your trapping problem by standardizing on Yarways. They provide *quicker heating; greater sustained heating efficiency; lower installation and maintenance cost; fuel economy; saving in valuable floor space* due to their small size.

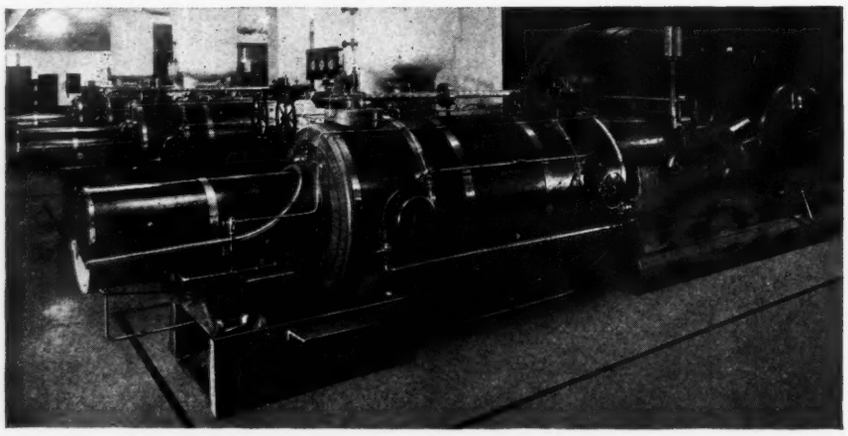
Then too, you probably can install new Yarways for *no more than the cost of repairing* the *old traps* in your plant. It's often the case.

See your mill supply dealer—or write for Catalog T-1735.

**YARNALL-WARING COMPANY**
**100 Mermaid Avenue Philadelphia**

# YARWAY IMPULSE STEAM TRAP

# Cylinder Lubrication With Superheated Steam (Continued from page 114)



**Three 400-kw horizontal engines, operating on 190-lb steam with 150-F superheat, supply power to a newspaper printing plant**

present a problem in lubrication because a temperature drop occurs between the boiler room and engine throttle valve. Upon expanding in the high-pressure cylinder, the steam will become wet and the average cylinder-wall temperatures will not be excessive, even if steam jacketed. However, with more than 100 F superheat, it is generally necessary to use a premium-grade steam-cylinder oil, either a filtered stock, or, better still, a bright stock. The latter type contains a minimum amount of carbon-forming material and assures comparative freedom from deposits.

### *Small Amount of Tallow*

Very little tallow oil should be used because it tends to disintegrate at the temperatures of superheated steam. However, for non-condensing engines, intermittent operation, or on locomotive-type engines, a small amount of tallow oil is sometimes advantageous to produce an emulsion. For example, when the hot steam strikes the comparatively cool steam chest and cylinder walls of an engine that is continually starting and stopping, there will be sufficient condensation to warrant adding 3 to 5% compounding. For condensing engines, straight mineral oils are essential to secure good separation of oil from water.

The real problem begins when there is more than 100 F of superheat in the steam. For example, with a boiler pressure of 250 lb g, the steam temperature will be 405 F; if the superheater adds 200 F, total steam temperature is 605 F. At temperatures above 600 F it should now be obvious that an oil film of microscopic thickness must commence to carbonize and produce deposits. This fact has led to a number of misconceptions in lubricating steam engines supplied with high-temperature steam.

Contrary to general belief, there is no advantage in using the heaviest-bodied oils obtainable. Such oils contain a high percentage of carbon-forming material and defeat their purpose for this reason. Furthermore, they have little more body than other oils at high temperatures; therefore, have little advantage in the strength of the oil film maintained on cylinder walls to resist rupture by the piston rings.

Best results on high-temperature service will be secured with a "bright stock." Saybold viscosity reading should not be more than 230 sec at 210 F. There is no simple rule to determine the most suitable viscosity or the best rate of oil feed to give maximum lubrication and minimum deposit formation. Only periodic examination of cylinder walls will reveal this condition and guide the engineer to the answer for a particular engine.

### *Carbonizing Characteristics*

Different types of cylinder oils have different carbonizing characteristics. There is also a "time element" in the rate at which disintegration takes place on oil films of microscopic thickness, subjected to high temperatures. This temporary resistance to heat affects the deposit formation.

An important detail that will assist lubrication is to give the oil film every chance to resist rupture by rounding the edges of the piston rings. If the rings have sharp edges, they will act as scrapers and materially cut down the oil film, thus necessitating a higher rate of oil feed than otherwise required.

An interesting sidelight on research along the lines of improving lubricating oils for different purposes is that of adding compounds to achieve certain results. For example, by the addition of a "dope," it is possible to lower the pour point of an oil, that is, make it pour at a lower temperature when subjected to freezing. Unfortunately, no compound has been discovered that will raise the flash and fire points of lubricating oil and thereby provide them with greater resistance to heat. Hence, at steam temperatures above 650 F, the best that can be done is to select a comparatively heavy-bodied "bright stock" to give minimum deposit formation with maximum results in oil film maintenance.

### *Saybolt Viscosity*

As stated above, Saybolt viscosity of 230 sec at 210 F is about the limit of practical application with superheated steam. More generally, it will be found that bright stocks with a Saybolt viscosity of 150 to 200 sec at 210 F will give best results with high superheat. However, there are cases where even lighter-bodied oils have proven successful with high-temperature steam.

In the matter of compounding at high temperatures, the use of tallow oil is not generally recommended. However, where engines are operating on intermittent load, a small percentage of tallow oil is sometimes advantageous. If there is some moisture occurring on the metal surfaces an emulsion will be formed and the tallow oil becomes more resistant to disintegration, and lubrication is improved under these conditions.

There are many details to watch in applying steam-cylinder oils. For example, the lubricator should not be placed smack up against a hot steam pipe or cylinder. The cooler the oil upon delivery into the steam line or, as the case may be, directly to the cylinder, the less the thinning effect upon the oil. In the opinion of the writer, there are many instances where lubrication could be improved by actually cooling the oil pipes from the lubricator and thereby delivering the cylinder oil at the lowest possible temperature.

NALCO has a long record of having aided power plants in 2 ways to increase their steam and power output without adding new equipment:

1. BY MAKING HIGHER OPERATING RATES POSSIBLE AND PRACTICAL. This means protection against carry-over, ability to stand up under higher heat release rates, and production of more steam per B.T.U. of fuel.

2. BY KEEPING BOILERS CONTINUOUSLY CLEAN OVER LONG PERIODS OF TIME. Lower outage requirements have increased net effective boiler plant capacity.

For complete information about the Nalco System, write today. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Ill.

**The Nalco System of Feedwater Treatment**

Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

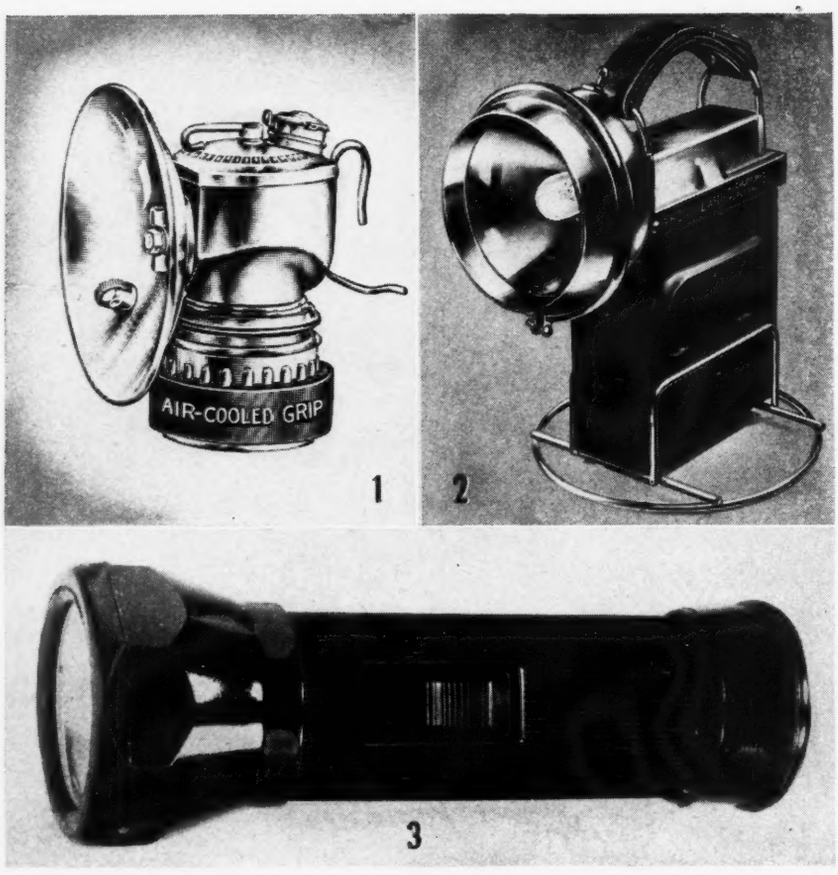



**Fig. 1—Acetylene-gas miner's lamp gives non-glare, soft light. Fig. 2—Storage-battery lamp is comparatively light in weight and gives long service on a single charge. Fig. 3—This flashlight has an unbreakable lens and soft rubber cushions its parts**

# Safe Lighting for Boiler Interiors

***Harry M Spring describes lighting units safe to use inside of boilers and points out the hazards of using 110-volt lamps, ordinarily considered safe***

► NOT SO LONG AGO the candle was used extensively to illuminate boiler interiors as an aid in cleaning, maintenance and inspection. The next practical light development for this work was the miner's carbide lamp, Fig. 1, which uses acetylene gas. This light has been so satisfactory that it is still preferred by many for a non-glare, soft light to show defects not so clearly visible in the glare of a more brilliant and less diffused electric light.

The carbide light has the advantage that it can be used to test the ignition tendency of deposits suspected of containing oil; it is quite rugged, and has no delicate parts to break easily if the lamp is dropped. It should never be used, however, where combustible vapors make an open flame an explosion hazard.

Flashlights have been used for boiler-inspection service, but for many years gave trouble because they were not sufficiently rugged to withstand rough usage. Often they were dropped or struck against some object in a boiler, which usually broke the bulb or lens. Exposure of the reflector to dampness and dirt greatly decreased its useful life.

Out of this experience came the flashlight shown in Fig. 3. The lens is flexible and practically unbreakable. All important parts are cushioned by soft rubber, which also protects internal parts against moisture. I have seen flashlights of this type dropped over 25 ft without breaking the bulb or causing other damage.

Electric extension-cord lights operating on 110 volts may be exceedingly dangerous in a boiler or any other grounded, conductive object. If power for the lamp is taken from a 2300-volt line through a transformer, it is possible to get 2300 volts on the lamp circuit because of faulty insulation between primary and secondary windings of the transformer. Even the usual 110-volt potential is often fatal when one is in contact with a dead ground.

When a workman is in a boiler or tank with his clothes and shoes wet, he makes a low-resistance ground for any accidental electrical contact. Often, too, he is in a cramped position where it is impossible to get free from such a contact even if he were able.

Be sure to keep common extension cords out of and away from all boilers, piping, and tanks. If extension cords are used, they should be of highest quality with heavy high-grade rubber covering and with lamp guards made of heavy insulating material.

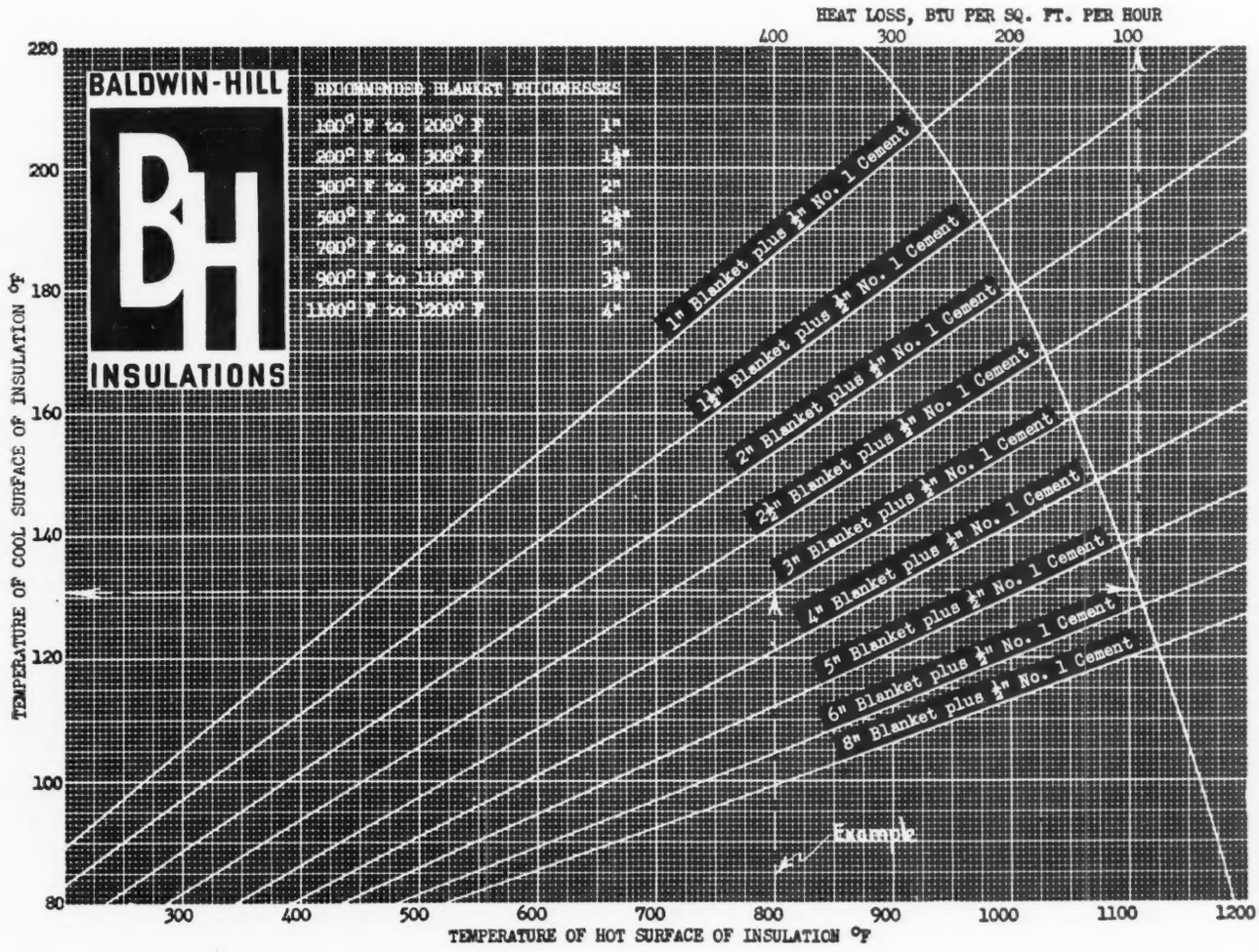
The light, Fig. 2, is representative of a portable electric light that can be used in and around steam boilers or tanks. The power unit is a non-spillable, rechargeable storage battery. Solution for the battery is held in suspension by sponge-like separators between the plates. The volume of light is practically constant throughout the discharge capacity of the battery and the light may be focused as desired. The beam has 25,000 candlepower and a long range, useful in furnaces of large, high-set boilers. In spite of the 20-hr service discharge capacity of the battery, the weight of the entire unit is only a little over 6 lb. A special high-power filament supplements the regular-service filament in the bulb.

Low-voltage electric lights are also used extensively where there is possibility of an accident caused by 110 volts. These units consist of a low-voltage lamp on an extension cord connected to a 10- to 30-volt circuit supplied by a 110-volt transformer.

The author wishes to thank the Koehler Manufacturing Co, Inc, Marlboro, Mass.; Justrite Manufacturing Co, Chicago, Ill.; and Ray-O-Vac Co, Madison, Wis., for their assistance in preparing this article.

# HEAT LOSS CHART

## on Combination BALDWIN-HILL Black Rockwool BLANKET and No. 1 INSULATING CEMENT showing why Plant Equipment, insulated with these materials, operates at Maximum Efficiency and Economy . . . .




**Example: Assume that it is required to insulate a surface at a temperature of 800° F. Referring to the table, a 3" B-H Black Rockwool Blanket finished with ½" of B-H No. 1 Insulating Cement is required. Follow vertically on the chart from the 800° F. point to the intersection with the curve for this recommended thickness. From that point follow horizontally to the left, and read 131° F. Cool Surface Temperature. From the same point follow horizontally to the right to the intersection with the heat loss curve, and then vertically to read 92 Btu's per square foot per hour heat loss.**

★ ★ ★ ★ ★


**BALDWIN-HILL CO.**

**575 KLAGG AVE. . . . . TRENTON, N. J.**

# NAPE Elects Beiswenger President

***Power engineers, meeting in 58th annual convention at Columbus, Ohio, choose Goodyear chief as leader. Baltimore, Md., named 1941 convention city***

Otto L. Beiswenger (left) was elected president and Stephen C Casteel vice-president

Treasurer for coming year is George M Diebold, past national president

Thomas R Herlihy (center), elected trustee, is flanked by past national president John A Prudell (left) and by H H Foreman (right) of Los Angeles

▶ Columbus, Ohio, August 23—Meeting in this Midwestern city for its 58th annual convention, under the leadership of National President Carl R Daubenmire, the National Association of Power Engineers elevated vice-president Otto L Beiswenger to the presidency of the national organization and chose Baltimore, Md., as the convention city for 1941. Mr Beiswenger is power engineer for the Goodyear Rubber Co in Akron, Ohio.

Other officers elected include Stephen C Casteel, Davenport, Iowa, vice-president; George M Diebold (past national president), Buffalo, N. Y., treasurer; Fred W Raven, Chicago, Ill., re-elected as secretary for the 40th consecutive year; Thomas R Herlihy, Los Angeles, Calif., trustee.

Throughout a week of perfect weather, 31 manufacturers exhibited power equipment and supplies on the main floor of the Columbus Auditorium. The business meetings of the association were held in an adjoining room. Problems discussed included license-law legislation and similar matters affecting the membership.

Technical lectures were delivered by Captain A A Nicholson (practical education); Dean C H McQuigg, Ohio State University (power resources and national defense); Dr Phillips Thomas, Westinghouse (research demonstration); Professor Paul Bucher, Ohio State University (safety valves).

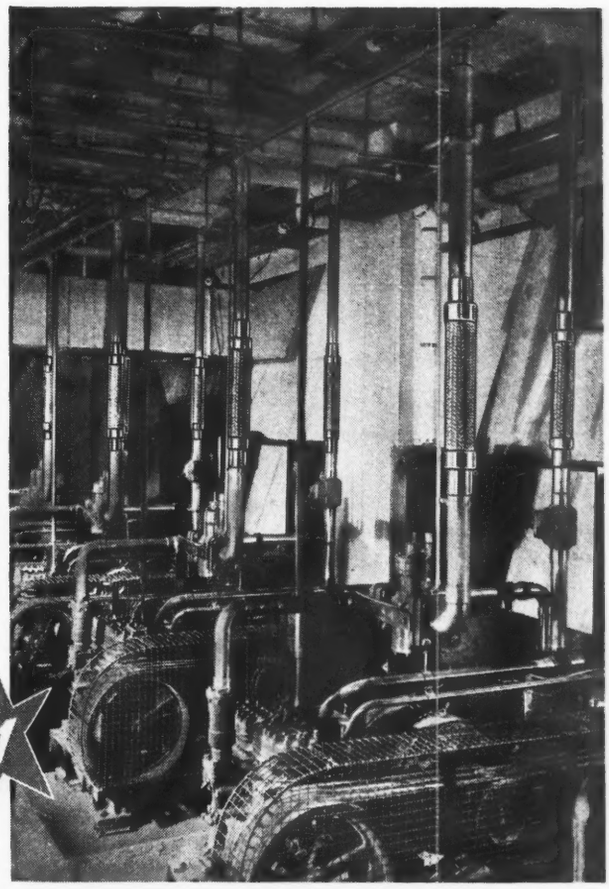
Social and other special events included receptions to the outgoing and incoming national officers, the annual entertainment (in charge of Stuart Fisher, Columbus, and Bob Jones of Jenkins Bros), the various state dinners and a well-attended testimonial dinner for Fred Jolley, retiring representative of Jenkins Bros.

Total registration, including many members of the Ladies Auxiliary, was approximately 500.

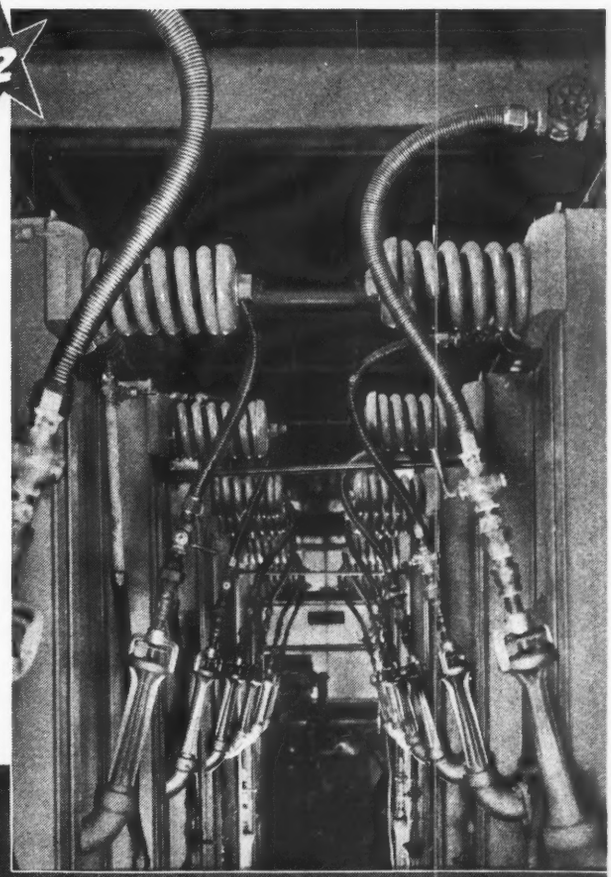
# A connector with a DUAL PERSONALITY

*It is seamless, all-metal, as strong as rigid pipe*

*It's as flexible as garden hose*



1 **Silence** Here vibration eliminators of seamless flexible metal tubing take the chatter out of pipe lines. They are strong enough to withstand thousands of pounds pressure—seamless to convey penetrative freon gas with the utmost safety—and flexible to eliminate destructive vibration.



2 **No Hazard** Firing annealing furnaces with butane gas requires a gas conveyor that is flexible and pressure-tight. This picture shows American Seamless doing the job as no other tubing can. It is flexible to permit easy opening and closing of furnace doors, yet as strong and tough as the seamless metal tube from which it is made.

• • •

American Seamless Flexible Metal Tubing has no joints, welds or seams of any kind. It has flexed millions of times without breaking down. Available in various metals with fittings completely assembled. Publication SS-25 on request.

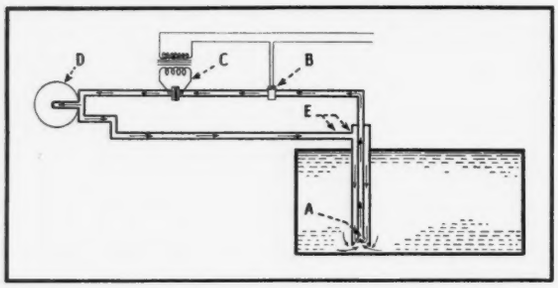
40242

*American Metal Hose*

ANACONDA from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
*In Canada: Anaconda American Brass Ltd., New Toronto, Ont.—Subsidiary of Anaconda Copper Mining Co.*

# WHAT'S NEW IN PLANT EQUIPMENT



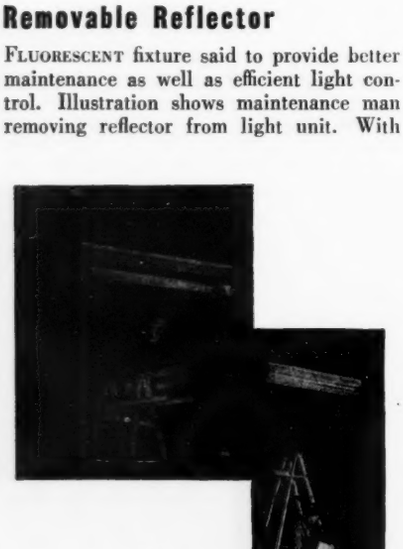

## Oil Heater

LINES thermal electric conduction system for heating viscous fluids makes entire piping system long heating unit. Basic parts of the system are heavy-duty transformer, electrically insulated tank head with suction and return outlets, and thermostat. Special transformer at *C*, in illustration, supplies electrical energy to make the piping a long heating system, heating the entire line of flow, so that oil, entering at *A*, is continually being heated as it flows to *D*, point of use. Proper temperature is maintained by thermostat at *B*. Surplus oil is further heated as it returns through *E* to point of suction *A*, and is redrawn into the system.

*Albert G Purdue Associates, 303 Wooster St, New Haven, Conn.*

## Removable Reflector

FLUORESCENT fixture said to provide better maintenance as well as efficient light control. Illustration shows maintenance man removing reflector from light unit. With



extra reflectors on hand, all that is necessary is to remove dirty reflector, insert clean one, with minimum loss of light and time. Old ones can be cleaned and stored, ready for quick replacement. Reflector is of Alzak aluminum.

*Edwin F Guth Co, 2615 Washington Ave, St. Louis, Mo.*

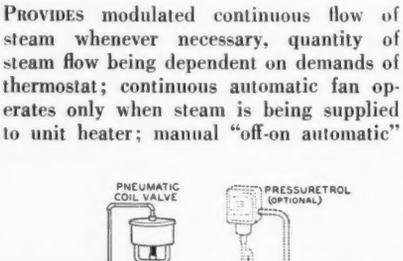
## Pulley Oiler

TRICO oiler operates on three different principles: thermal, capillary, and gravity action. Copper tube transmits heat of pulley hub to oil reservoir, to produce quick thermal action, wire reinforced wick feeds oil by capillary action, and it is dropped on bearing by gravity. No attention required save occasional filling of reservoir.

*Trico Fuse Mfg Co, 2955 N 5th St, Milwaukee, Wis.*

## Unit-Heater Control System

PROVIDES modulated continuous flow of steam whenever necessary, quantity of steam flow being dependent on demands of thermostat; continuous automatic fan operates only when steam is being supplied to unit heater; manual "off-on automatic"




switch permits fan to be run constantly or if no heat is required it may be shut off. An optional feature is a means of automatically shutting off the fan when there is no steam pressure in the main steam line. System may be pneumatic, as illustrated, or electric.

*Minneapolis-Honeywell Regulator Co, 2747 Fourth Ave, S Minneapolis, Minn.*

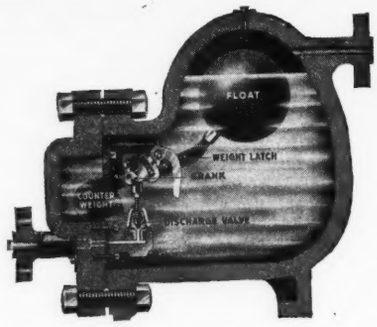
## Rubber Compound

SYNTHETIC compound is said to permanently retain its adhesion, elasticity and waterproofing qualities. Compound contains no disintegrating resins, asphalt or putty and is applied cold with a gun or trowel. Is said not to powder, become brittle, crack, or otherwise disintegrate. Watertight, it adheres to wood, stone, brick, concrete, metal, glass, etc.

*American Bar Lock Co, Inc, Ablo Products Div, Long Island City, N. Y.*

## Weight-Operated Trap

MODEL C TRAPS are recommended for draining headers, line purifiers, separators, etc. Water entering trap raises float to its highest point of travel, where it releases weight latch, allowing counterweight to fall. Counterweight is attached to crank which lifts discharge valve wide open im-




mediately. Discharge valve is then held wide open by link latch until discharging water carries float to its lowest point of travel. At this point weight latch engages counterweight, which has been lifted by falling float, and link-latch disengages, permitting discharge valve to close instantaneously.

*W H Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa.*

## Control Instruments

IMPROVEMENTS include new, more compact, amplifying pilot of high capacity; rearrangement of control assemblies so that all working parts, including gages, may be installed or removed as a unit; die-cast, streamlined aluminum cases; new type lock; time set pointer; rigid aluminum chart plate; etc. Features included in earlier models have been retained.

*Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.*

## Whiteprint Machine

MODEL F PRINTING MACHINE features newly developed high-pressure mercury-vapor tube for light source, which uses 40 watts to inch and provides uniform light over entire printing area. Original and sensitized materials are brought into exposure by carrier bolts which hold them against 4¼-in. diameter glass cylinder. Cylinder is suspended at

# PRODUCTION BLOCKED BY A SLUG OF WATER

## *A Case Story*

**SOLVED WITH PREVENTIVE MAINTENANCE**

TOMORROW—hundreds of plants may face a case like this: A midwestern manufacturer was suddenly swamped with orders. The plant had a good reserve capacity—yet, push as the management did, it failed to get the output needed.

The boilers and machinery were in excellent shape—but the steam lines were sluggish. The ailment was a common one—a condition that's quickly corrected with proper equipment.

That's how Preventive Maintenance entered the case. For, it's the only sure way of solving piping problems and keeping them solved. This simple technique guides you in installing and caring for pipe lines correctly; it helps you choose the right valves and fittings for every service.

This case shows how Preventive Maintenance works. While the management raved, the Superintendent put his hands on the trouble. The machines were not only slow in heating up, but they wouldn't stay hot. The drainage system was inefficient—it failed to remove condensate rapidly enough to keep the machines at maximum temperature.

The backlog of orders haunted the Superintendent. He wanted immediate correction of the drainage trouble as well as positive assurance it wouldn't happen again. He saw that more than ordinary maintenance was necessary. "The Crane man," he said as he reached for a phone, "will help us solve this quickly and surely."

The two men reviewed the situation. To run the machines at top speed meant keeping them at maximum temperature. Condensate would have to be drained as rapidly as it formed. The correct solution, as Preventive Maintenance counseled, involved redesigning of the drainage system, and installing a Crane Inverted Float Trap on each machine.

**Results: The condensate trouble was banished. Production was immediately doubled. Another user of piping knows the value of Preventive Maintenance. Also, knows that the best way to get most from piping maintenance dollars is to call in the Crane Man. Because, backed by Crane experience and the great Crane line of valves and fittings, he offers the means of a successful Preventive Maintenance program.**

*This case comes from the personal experience of W.F.C. —a Crane Representative in the Kansas City Branch*

### YOUR STEAM LINES KEPT HOT AND DRY WITH CRANE TRAPS

You are not getting the maximum heat and power from steam if your lines are not properly drained. You are straining the piping, shortening the life of valves, exposing steam-operated equipment to serious damage when condensate is not removed.

In steam lines up to 600 pounds pressure, the wasteful and damaging effects of condensate are completely eliminated with Crane Inverted Open Float Steam Traps. These sturdy, simple, and low-cost traps will pay for themselves many times over. Once installed they require minimum attention—yet, automatically, stop steam waste, step up efficiency.

For pressures up to 200 pounds, the Crane line of No. 981 traps will give maximum protection against condensate troubles.

35 YEARS

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO

*VALVES • FITTINGS • PIPE*
*PLUMBING • HEATING • PUMPS*

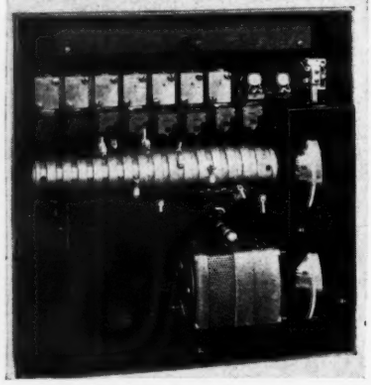
each end on three ball-bearing rollers and is revolved around mercury vapor tube by contact with carrier belts. Glass cylinder, tracing and sensitized material revolve at same speed, eliminating slipping and distorted prints. Mechanically controlled am-

monia vapors develop exposed prints, rubber belt carrying print over perforated top of developing tank. Print-return chute delivers finished print to front of machine dry and ready for use.

*Ozalid Corp, Johnson City, N. Y.*

## Time-Cycle Controllers

FLEX-O-TIMER is adaptable for all-electric, all-pneumatic operations, or combinations of both. New latch-trip solenoid-operated mechanism starts process instantaneously. This actuates one or more snap operators to start timer motor, which is high torque,



fan-cooled synchronous type, and any outside electrical or pneumatic functions to be performed simultaneously at start of the operation. External pushbutton or limit switch can be used to provide electrical contact to start process.

*Taylor Instrument Cos, Rochester, N. Y.*

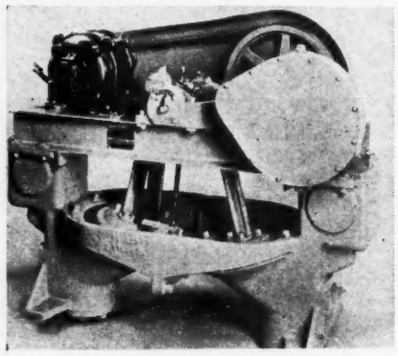
## Electrical Contacts

CONTACTS are constructed of highly fused pure tungsten metal, assuring, according to maker, uniform grain structure, eliminating any excessive oxidization or pitting during operation periods. Purity of metal avoids film coatings from adhering to contact surfaces during time when apparatus is not operating. Further claimed that due to elimination of difficulties electrical contact surface resistance is maintained at minimum.

*Metroloy Co, 57 East Alpine St, Newark, N. J.*

## Duplex Diaphragm Pump

DORRCO V-type pump is improved diaphragm pump designed for handling of sludges, pulps, or slimes containing appreciable quantities of solid materials. Has means of stroke adjustment while running, among other features. Variation in plunger stroke from ⅛ to 3 in., while



pump is running, can be made by turning crank. This gives 5 to 1 range in discharge rate. Other advantages claimed are less headroom needed, no gear motor required, higher mechanical efficiency, long diaphragm life, and acid-proof construction.

*Dorr Co, Inc, 570 Lexington Ave, New York, N. Y.*

## Electric Detector for Boiler Tubes (Below)

SPERRY unit is supplied on rental basis, and is supervised by Sperry engineers. Detector is compactly constructed and may be conveniently located in any tube mill. Equipment is table mounted, including amplifiers, energizing coils and detector coils, drive rolls, and controls. Underneath table are mounted motor-generator set for supplying energizing current, roll-drive motors, and other related parts. Can be operated separately from tube construction, giving advantage of being able to test different size tubes. Automatic control stops tube movement at each defect signal, and testing speeds may be varied from 16 to 100 fpm, depending on type of defects required to be found, which include slivers, seams, dents, etc. Defects may be visible or invisible to the eye, internal or external. Calibration of equipment permits sensitivity according to size of defects to be detected.

*Sperry Products, Inc, 1505 Willow Ave, Hoboken, N. J.*

## Torque Indicators

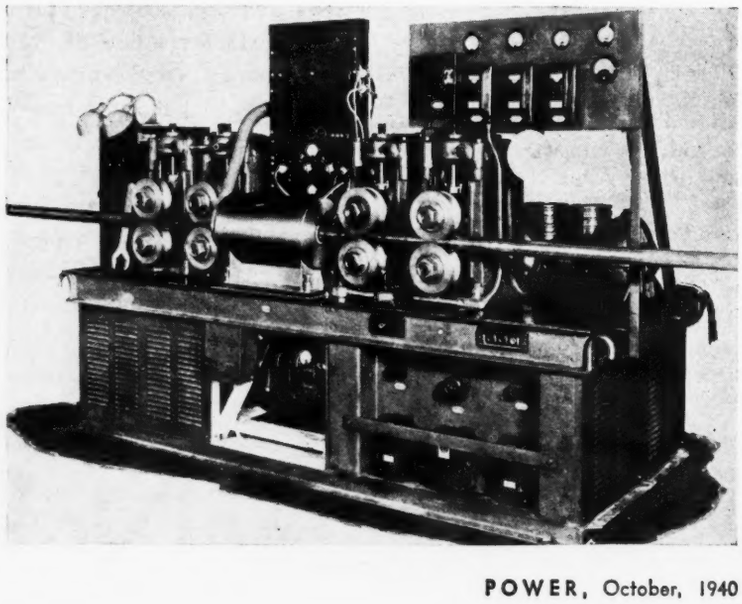
USED in drawing up a bolt, or a series of bolts, to proper tension, additions to line of wrenches have maximum capacities of 133, 175, 420, and 1000 ft-lb. Two models available. In smaller sizes the Torkflash has flashlight signal showing when desired tension has been reached, and larger sizes have Stay-set dial, which indicates maximum torque reading after tension has been released.

*Blackhawk Mfg Co, Milwaukee, Wis.*

## Photoelectric Combustion Control

ROBOT-EYE UNIT controls flow of air into furnace, so that fuel-air ratio is maintained to produce slight haze in flue gases and therefore keep combustion at highest practical efficiency. Basic system for natural-draft installations comprises integrated operation of electric-type furnace-draft-regulator and photoelectric cell, which control fuel-air ratio by operation of motorized uptake damper. Draft regulator maintains furnace draft within predetermined limits, but if draft so established does not maintain fuel-air ratio required to produce desired flue-gas haze, then electric eye, through its compensating system, increases or decreases draft setting just

*(Continued on Page 138)*



# WANT THIS KIND OF MOTOR PERFORMANCE IN YOUR PLANT?

## Read These Interesting True Case Histories of How Allis-Chalmers Lo-Maintenance Motors are Providing Long-Life . . . Low-Cost Motor Service to Industry!

GET THIS type of up-to-date motor performance in your plant . . . and assure yourself long motor life plus low maintenance . . . with Allis-Chalmers Lo-Maintenance Motors.

For, in Lo-Maintenance Motors, you get such "full-measure" features as—distortionless, twistless stator . . . indestructible, removable rotor . . . high carbon steel frame . . . no skimping anywhere on materials or workmanship!

These are important features . . . designed to give you motor performance that is more than just a rated horsepower. Let the engineer in the district office near you explain them to you. Call him . . . today. Or write Allis-Chalmers, Milwaukee.

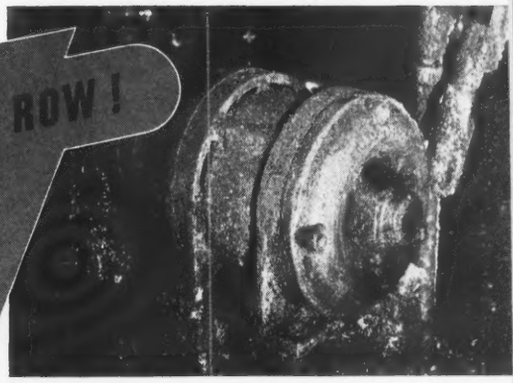
A 1241

### 8½ YEAR REPAIR BILL—$000.00!

In this Cincinnati factory, 119 Allis-Chalmers Lo-Maintenance Motors have gone more than 8½ years without one cent spent for repairs . . . typical of Lo-Maintenance money-saving performance.

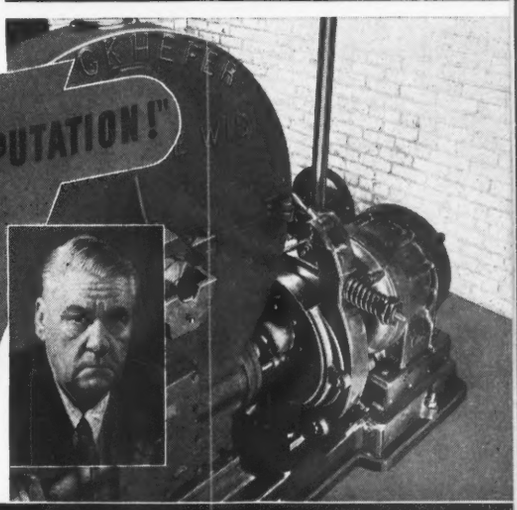
### 5 YEARS ON SUICIDE ROW!

Not a pretty picture! But this Lo-Maintenance Motor was running perfectly five years after it was installed on "suicide row" in this chemicalplant, where adverse operating conditions wrecked other motors in 60 to 90 days!



### "HELP PROTECT OUR REPUTATION!"

"Allis-Chalmers Lo-Maintenance Motors help us protect our reputation as builders of elevators that won't break down"—says E. F. Kieckhefer, vice-president, A. Kieckhefer Elevator Company.



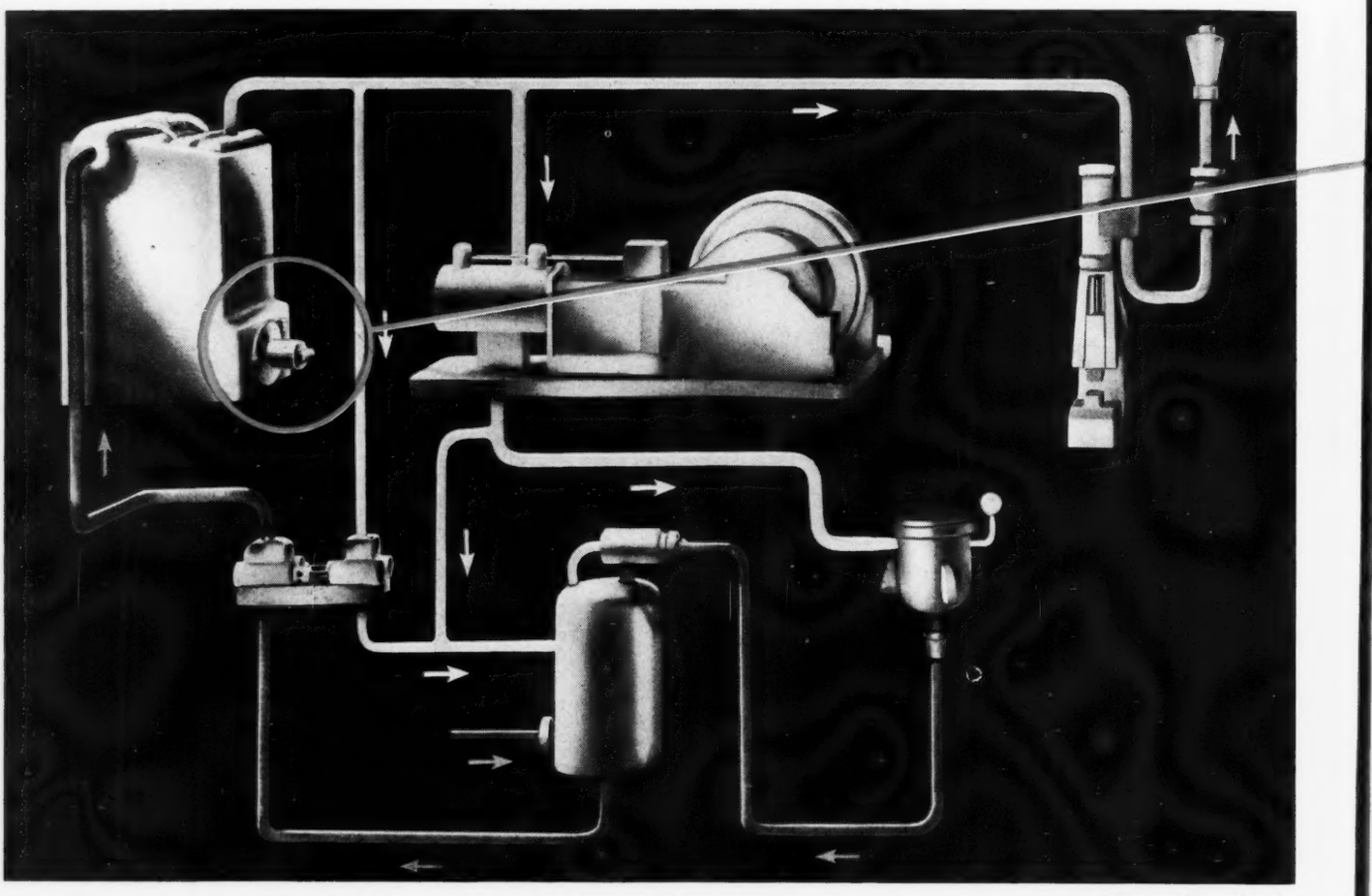
*Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!*

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

# FROM *GOOD* POWER HOOKUPS

## FOR OIL BURNER CONNECTIONS...



Courtesy—Power Magazine

**HOOKUP #23** **Boiler pressure in many industrial plants is fixed by h-p process requirements, with a turbine or engine exhausting to l-p process. Oil fired boilers are ideally suited to serve widely fluctuating process demands. In this simple hookup, power and process loads nearly balance but when process load exceeds power demands there should be a reducing valve between main steam and process headers.**

---

AUTOMATIC operation of oil-fired boilers with No. 6 on Bunker "C" fuel requires an auxiliary method of heating the oil and controlling the temperature.

Pre-heating is generally done with steam-supplied units although some systems also utilize an electric heater for starting up and booster service.

For efficient atomization, fuel oil must be kept under some pressure to prevent gasification and formation of air pockets. This diagram, therefore preheats oil only on the discharge side of the pump.

Power engineers who have followed the other hookups in this series will realize that the diagram shown is not intended as a rigid piping recommendation—but rather to show vital control points and the valves which Jenkins recommends for each service.

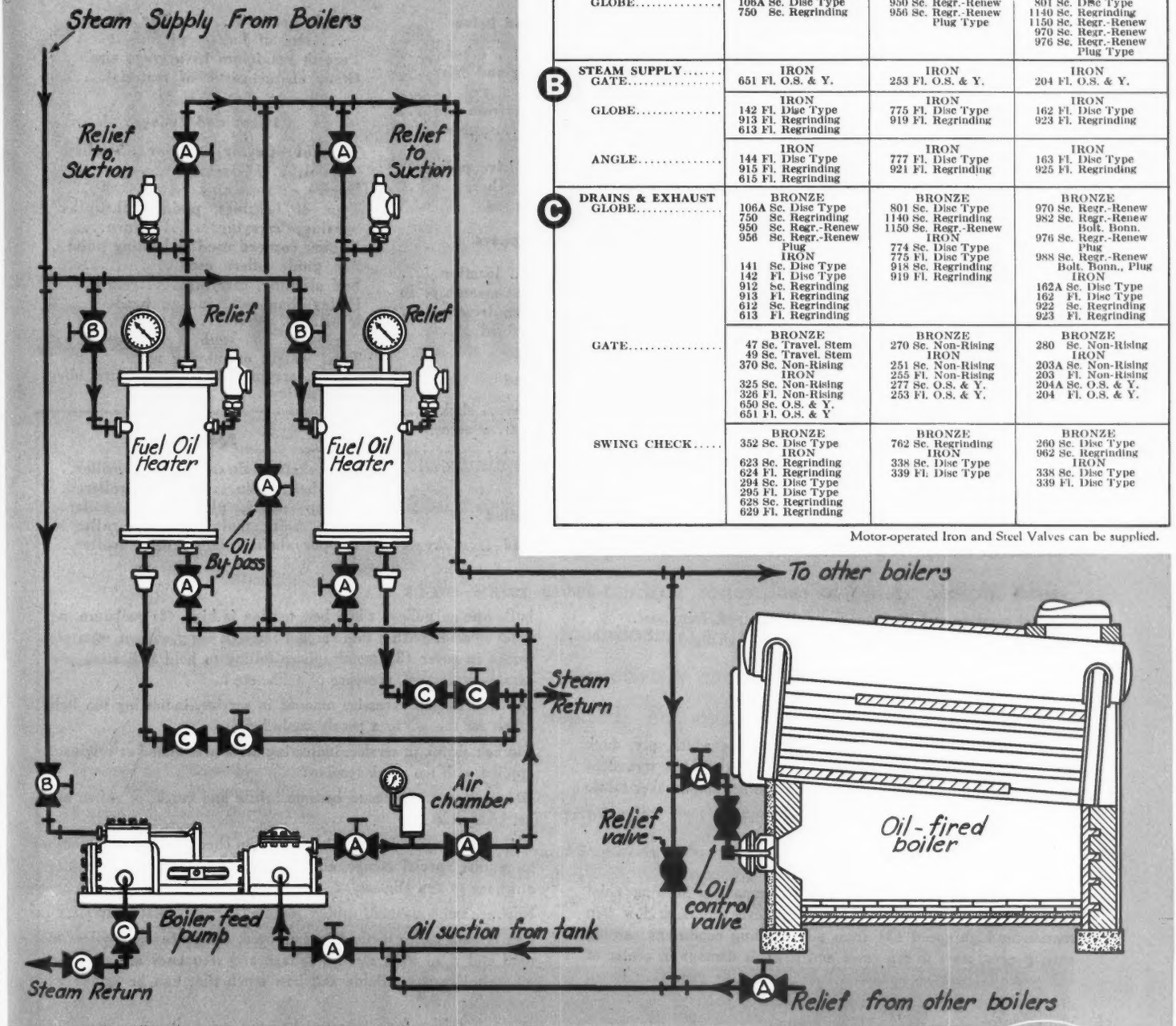
**NEXT MONTH—STEAM DRAIN CONNECTIONS**

IN VALVES *Jenkins* GIVES YOU EVERYTHIN

# . . . . TO *GOOD* VALVE PRACTICE

# *Jenkins* RECOMMENDS . . .

## FUEL OIL AND STEAM AUXILIARIES




### REFERENCE CHART TO JENKINS FIGURE NUMBERS FOR OIL BURNER CONNECTIONS

| | | Standard | Medium | Extra Heavy |
|---|---|---|---|---|
| A | FUEL OIL LINES GATE | BRONZE<br>47 Sc. Travel. Sping.<br>370 Sc. Non-Rising<br>IRON<br>325 Sc. Non-Rising<br>326 Fl. Non-Rising<br>650 Sc. O.S. & Y.<br>651 Fl. O.S. & Y. | | |
| | GLOBE | BRONZE<br>106A Sc. Disc Type<br>750 Sc. Regrinding | BRONZE<br>950 Sc. Regr.-Renew<br>956 Sc. Regr.-Renew Plug Type | BRONZE<br>801 Sc. Disc Type<br>1140 Sc. Regrinding<br>1150 Sc. Regr.-Renew<br>970 Sc. Regr.-Renew<br>976 Sc. Regr.-Renew Plug Type |
| B | STEAM SUPPLY GATE | IRON<br>651 Fl. O.S. & Y. | IRON<br>253 Fl. O.S. & Y. | IRON<br>204 Fl. O.S. & Y. |
| | GLOBE | IRON<br>142 Fl. Disc Type<br>913 Fl. Regrinding<br>613 Fl. Regrinding | IRON<br>775 Fl. Disc Type<br>919 Fl. Regrinding | IRON<br>162 Fl. Disc Type<br>923 Fl. Regrinding |
| | ANGLE | IRON<br>144 Fl. Disc Type<br>915 Fl. Regrinding<br>615 Fl. Regrinding | IRON<br>777 Fl. Disc Type<br>921 Fl. Regrinding | IRON<br>163 Fl. Disc Type<br>925 Fl. Regrinding |
| C | DRAINS & EXHAUST GLOBE | BRONZE<br>106A Sc. Disc Type<br>750 Sc. Regrinding<br>950 Sc. Regr.-Renew<br>956 Sc. Regr.-Renew Plug<br>IRON<br>141 Sc. Disc Type<br>142 Fl. Disc Type<br>912 Sc. Regrinding<br>913 Fl. Regrinding<br>612 Sc. Regrinding<br>613 Fl. Regrinding | BRONZE<br>801 Sc. Disc Type<br>1140 Sc. Regrinding<br>1150 Sc. Regr.-Renew<br>IRON<br>774 Sc. Disc Type<br>775 Fl. Disc Type<br>918 Sc. Regrinding<br>919 Fl. Regrinding | BRONZE<br>970 Sc. Regr.-Renew<br>982 Sc. Regr.-Renew Bolt. Bonn.<br>976 Sc. Regr.-Renew Plug<br>988 Sc. Regr.-Renew Bolt. Bonn., Plug<br>IRON<br>162A Sc. Disc Type<br>162 Fl. Disc Type<br>922 Sc. Regrinding<br>923 Fl. Regrinding |
| | GATE | BRONZE<br>47 Sc. Travel. Stem<br>49 Sc. Travel. Stem<br>370 Sc. Non-Rising<br>IRON<br>325 Sc. Non-Rising<br>326 Fl. Non-Rising<br>650 Sc. O.S. & Y.<br>651 Fl. O.S. & Y. | BRONZE<br>270 Sc. Non-Rising<br>IRON<br>251 Sc. Non-Rising<br>255 Fl. Non-Rising<br>277 Sc. O.S. & Y.<br>253 Fl. O.S. & Y. | BRONZE<br>280 Sc. Non-Rising<br>IRON<br>203A Sc. Non-Rising<br>203 Fl. Non-Rising<br>204A Sc. O.S. & Y.<br>204 Fl. O.S. & Y. |
| | SWING CHECK | BRONZE<br>352 Sc. Disc Type<br>IRON<br>623 Sc. Regrinding<br>624 Fl. Regrinding<br>294 Sc. Disc Type<br>295 Fl. Disc Type<br>628 Sc. Regrinding<br>629 Fl. Regrinding | BRONZE<br>762 Sc. Regrinding<br>IRON<br>338 Sc. Disc Type<br>339 Fl. Disc Type | BRONZE<br>260 Sc. Disc Type<br>962 Sc. Regrinding<br>IRON<br>338 Sc. Disc Type<br>339 Fl. Disc Type |

Motor-operated Iron and Steel Valves can be supplied.

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

Bridgeport • Boston • Chicago Philadelphia • Atlanta • Houston

#23 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 99

# Check Data For Conveyor Belts

WHEN BUYING a new belt, investigating trouble with one already in service, or simply keeping a record of belt costs, fill out as much of the following information as applies to the case in hand. This check asks for the data a manufacturer needs to recommend right material and size; it also gives an operator answers to service problems.

Conveyor No.....Location.....
Plant.....Date Installed.....
Report made by.....Date.....

### Conveyor

Center to center distance between head and tail pulleys over conveyor.....ft
Horizontal center-to-center distance between head and tail pulleys.....ft
Total lift or drop between head and tail pulleys .....ft
Maximum incline.....degrees.....%
Belt speed running empty.....fpm
Belt speed loaded.....fpm
Belt width.....in.
Capacity .....cfh

### Motor

Start across line.....transformer.....
delayed.....no. of starting points....
seconds to come up to speed.....
Input to motor starting loaded belt..hp
Input to motor running loaded belt..hp
Input to motor starting empty belt..hp
Input to motor running empty belt..hp
Dual motor drive...(give data on both)

### Speed Reducer and Drive

Belt.... gear.... chain.... other.....
Estimated efficiency, motor and drive..%
Drive at head pulley.....tail.....
intermediate....distance from head...
Type of drive, simple....snubbed....
tandem....
Arc of contact, belt and drive pulley...
Drive pulley lagged.....bare.....

### Takeup and Trippers

Gravity..... screw..... location.....
Total movement..ft, weight assembly..lb
No. of trippers.....power driven.....
hand driven..... fixed.....

### Type of Feed

Chute.... hopper.... pan.... shaker...
shovel... crusher... belt... screen...
Total drop to belt.....ft
Number of loading points.....

### Material Handled

Wet... dry... hot... cold... sticky...
Weight per cu ft...avg. size of pieces...
....size of largest piece.....
Percent maximum to average size.....
Other characteristic of material.....

### Idlers and Pulleys

Type of carrying, 3-pulley...5-pulley...
spool.... horizontal....
Degree of troughing rolls.....
Type of bearings, plain..ball..roller..
Spacing, carrying.....return.....
Rubber covered used at loading point...
Are guide idlers used.....
Self aligning, carrying.....return.....
Pulley diameters, inches, head.....
tail..... drive..... takeup.....
tripper..... snub..... idler.....
Total weight of moving parts
.....carrying idlers .....return idlers
all pulleys.....

### Bearings

Head shaft, plain.....ball.....roller....
Tail shaft, plain.....ball.....roller.....
Takeup shafts, plain...ball...roller...
Drive shafts, plain....ball....roller....
Tripper shafts, plain...ball...roller....

General condition of equipment, excellent, good, fair, poor.
Equipment changes (give date and nature of change).

Is belt stopped and started often?

Is belt started when loaded?

Is belt covered, or exposed to weather?

What belt construction has been used? Give width, ply, duck weight, friction quality, skim coat if used, anti-mildew treatment if used, cover, quality and thickness top and bottom, breaker fabric location if used, and any special features.

Total life of belt in years.

Total tons carried.

How did previous belts fail (1) from impact at loading point (2) from impact of heavy large lamps over idlers at low belt tension or high speed (3) from poor loading conditions causing cuts, gouges, tears in top cover and if so, is damage in center of belt width or parallel with skirt board indicating poor skirt board design or lack of belt support beneath loading point?

Did belting wear out from abrasion alone?

Does edge wear indicate off-center loading, misalignment of conveyor or idlers, too stiff a belt to trough properly?

If belt has carcass breaks, are these caused from (1) excessive build-ups on pulleys when belt tension is high (2) moisture, rot, mildew, acid, getting into carcass through cover cuts or even pinpricks in cover (3) metal splices failing to hold indicating poor carcass protection, presence of acids, etc.?

Did belt stretch excessive amount in service, indicating too light a belt for the job or a poorly made belt?

Did belt shrink in service, indicating drive over-belted or originally applied with too much tension?

Did heat cause covers to become brittle and crack, or soften and get tacky?

If belt was exposed to weather, is it sun-checked seriously enough to require special compounding (usually necessary only at high altitudes in dry climates)?

How are belts cleaned, rubber scrapers, brushes, water, air?

Can present splice method be improved, can vulcanized splices be used and if so what electric voltage and frequency are available, are belt clamps available and how much time can be spared for making splices?

Has belt failure been hastened because cuts and gouges were not repaired by vulcanizing and should vulcanizer with spanner clamps be kept at hand for making regular repairs?

*Prepared by C W Staacke, B F Goodrich Co*



© POWER

# Ordered for more than

# 1,000,000

# boiler horsepower

No other steam-flow type feed water regulator has ever been accepted so widely, so quickly. You can find installations of the COPES Flowmatic:

★

In 25 states and in 10 other countries—on 4 of the 5 continents.

★

On B. & W., Badenhausen, Bigelow, C-E, Edge Moor, Erie City, Foster Wheeler, Riley, Springfield, Union, Vogt and 10 other makes of boilers.

★

On boilers operating at pressures of from 80 to 1325 pounds gage.

★

On boilers having capacities from 15,000 to 550,000 lbs. per hour.

To be specific . . . in little more than three years, the COPES Flowmatic Regulator has been ordered for 225 boilers with a total steaming capacity of 36,897,450 pounds per hour. And for good reason. The COPES Flowmatic gives remarkably close water level control, regardless of boiler design, pressure or load conditions. Yet the design is so mechanically simple, the construction so rugged, that no more than routine servicing is needed. For complete information on this two-element steam-flow type regulator, write for Bulletin 429.

NORTHERN EQUIPMENT CO., 1001 GROVE DRIVE, ERIE, PA.

*Feed Water Regulators, Pump Governors, Differential Valves*
*Liquid Level Controls, Reducing Valves and Desuperheaters*

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY FLOWMATIC ★ REGULATOR

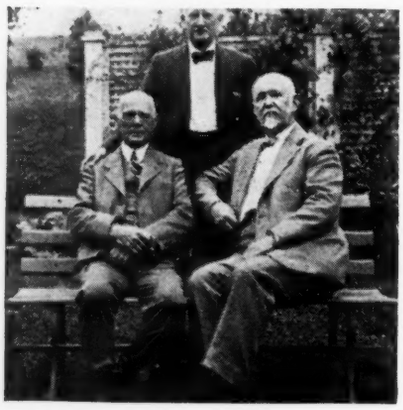
# POWER LINES

## Lester P Breckenridge Dies

Lester Paige Breckenridge, 82, Professor Emeritus of Mechanical Engineering of Yale University, died September 2 at his home in North Ferrisburg, Vt., where he had resided since his retirement seventeen years ago.

Professor Breckenridge had served as Chairman of the Advisory Board of the Superpower Survey, 1920–1921, a member of the World Power Conference, Vice President of the ASME, and Vice President of the Western Society of Engineers. He is remembered chiefly, however, as an outstanding personality in the field of engineering education.

Born in Meriden, Conn., May 17, 1858,



**Professor Breckenridge (right) seated with his friend Fred R Low (Editor of POWER from 1888 to 1930) at "Breck's" farm at North Ferrisburg, Vt., Sept 15, 1931. Standing is George A Orrok, consulting engineer**

he graduated from the Sheffield Scientific School at Yale in 1881 and was instructor in mechanical engineering at Lehigh until 1891.

After two years as Professor of Mechanical Engineering at Michigan Agricultural College, he took the same position at the University of Illinois, where he remained until 1909. At Illinois he built up a complete mechanical engineering laboratory and established (in 1905) the well-known engineering experiment station of that university.

From 1909 until his retirement in 1923, Professor Breckenridge headed the Department of Mechanical Engineering, Sheffield Scientific School, established there a modern engineering laboratory and greatly changed teaching methods. He always maintained close contact with practical engineering work, such as testing of steam generating and using equipment, smoke investigations, etc.

At the time of Professor Breckenridge's retirement, a foreword of appreciation by F R Low, POWER's pioneering editor, appeared in the June 12, 1923, number of POWER. This is reprinted on page 57 of the present number.

He leaves a widow, his second wife, and two daughters by a former marriage, Mrs Henry B Dirks of East Lansing, Mich., and Mrs D B Luckenbill of Redlands, Calif.

## Eastern Utilities to Add 182,000 kw Capacity

Three large eastern utilities have recently placed orders for turbine-generator sets with the General Electric and Westinghouse Electric Companies. Consolidated Gas & Electric Co of Baltimore has ordered a 52,000-kw, hydrogen-cooled turbine-generator from General Electric, to be a 3600-rpm, tandem-compound, double-flow unit taking steam at 850 lb, 900 F, and operating at 1 in. backpressure.

Potomac Electric Power Co has ordered a duplicate of a unit shipped by General Electric in July of this year for installation in the Buzzard Point Station at Washington, D. C. Both units are 50,000-kw, 1800-rpm, single-casing, single-flow turbines, having steam conditions of 650 lb, 900 F, 1-in. abs backpressure.

Philadelphia Electric Co has ordered from Westinghouse Electric & Mfg Co an 80,0000-kw, hydrogen-cooled, 1800-rpm, single-cylinder turbine-generator designed for inlet steam conditions of 250 lb, 570 F, and exhausting at 29 in. Hg.

## Burlington to Install Another 100,000 kw

As part of continuation of the expansion program at its Burlington station, Public Service Gas & Electric Co has placed an order for another 100,000 kw unit, to be ready for operation in 1943. The addition of the new unit will raise plant capacity from 55,000 to 255,000 kw, which figure includes an additional 100,000 kw now under construction for operation in December, 1940. The turbine-generator just ordered and one now being installed are cross-compound, condensing, each consisting of two 50,0000-kw elements, one high- and one low-pressure, operating at 1250 lb, 950 F, 3600 rpm.

## Los Angeles Orders 65,000-kw Turbine-Generator

Order for the largest 3600-rpm, condensing turbine ever built has been placed by the City of Los Angeles, Calif., with the Westinghouse Electric & Mfg Co. This will be a 65,000-kw unit to be installed in the Wilmington Station. Steam conditions are 850 lb per sq in., 900 F, and 29 in. Hg vacuum.

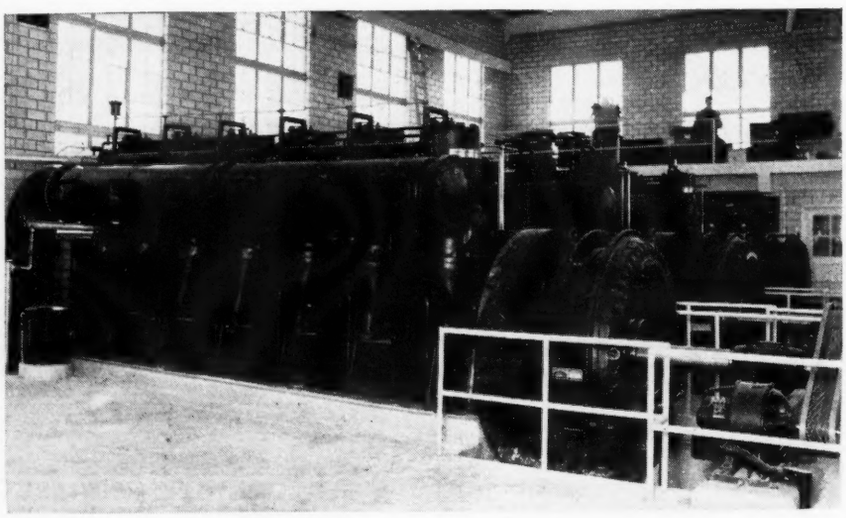
The turbine will provide reserve power for electricity received from Boulder Dam. It will carry a normal load of 50,0000 kw, being ready at a moment's notice to pick up full load of 65,000 kw, should an outage occur along the Boulder Dam line. The unit is scheduled to be placed in service in 1942.

## New Diesel Plant for Weatherford, Texas

The movement for a municipal plant for Weatherford, Texas, began in November, 1937, when the city voted $250,000 in revenue bonds for its construction. Litigation delayed operations until September, 1939, when contracts were let; the plant began operation in May of this year, with about 1200 of the city's 1600 meters connected, and with load growing fast.

The modern brick structure, well lighted and ventilated, houses three 450-hp engines and provides space for additional units when need arises. The 6-cyl, 14x17-in. Fairbanks-Morse diesels are of the

*(Continued on page 166)*



**New Weatherford, Texas, municipal plant contains three 6-cyl, 14x17-in., 450-hp diesels driving 1750-rpm, 0.8-pf, 300-kw alternators with V-belted exciter**

# *The New* Kennedy Catalog

**240 Pages**
**Page Size 8×10½**
**Cloth Bound**

## a Cyclopedia on Valves, Pipe Fittings, Fire Hydrants

You will find this new catalog a revelation in completeness—on details of design . . . . specifications of construction . . . information on correct selection and application . . . . accessories and attachments for individual operating conditions . . . . and helpful engineering data on pipe lines, flow of fluids, etc.—all arranged for quick and convenient reference.

The valves and pipe fittings described and listed in this catalog include bronze and iron body designs for every standard requirement on steam, water, oil, air and gas lines, with sectional views and part lists for every type of valve.

This catalog will prove a welcome aid in assuring the most suitable selection of valves and pipe fittings for your requirements. To obtain your copy, just fill in and mail the coupon, and be sure to do so TODAY.

**The Kennedy Valve Mfg. Co., Elmira, N. Y.**

# KENNEDY

**VALVES — PIPE FITTINGS — FIRE HYDRANTS**

Send the Coupon for Your Copy of Catalog

THE KENNEDY VALVE MFG. CO.,
1580 East Water St., Elmira, N. Y.
Please send copy of your new Catalog 63
Name .....
Position .....
Company .....
Address .....

# The Other Ways . . .

TWO STORIES ABOUT EDISON have always stuck with me. One is the yarn about his practical answer to a subordinate who said flatly one evening that there was only one way to do a particular job. The next morning Edison brought in a sheet of paper on which he'd scrawled 49 other practical ways to do it! The other occurred, while Edison was testing filament materials. After one particularly discouraging failure, one of his assistants said, "All these months of work, and nothing accomplished!"

"You're wrong!" exclaimed Edison, "We at least know nine hundred materials that *won't* work!"

Every one of us knows how pioneer thinkers have been persecuted and ridiculed since the world began—Jesus, Luther, Galileo, Pasteur, Darwin, Columbus, the Pilgrims, Edison, and more recently Einstein and Mann. They are doomed to mistreatment by the lack of vision of their fellow "thinkers." Of course, such failure to understand men of vision deserves criticism. But we chiefs are only too often similarly short-sighted and prone to condemn, hence just as deserving of criticism. The only difference is that our sphere is smaller.

To youth, everything is possible. Age brings conservatism and disbelief. And it is only to be expected that this should happen, for experience painfully pounds into most of us the knowledge that certain things *can't* be done—when what we should believe is not that they *can't,* but that they *haven't been done thus far.*

It is disillusioning experience that gradually builds those barriers all around our actions and reactions, then proceeds to thicken them until we find ourselves going 'round and 'round like a compass needle on a pivot. First thing we know, each little job, no matter how insignificant, must always be done in exactly the same way—*our* way—or it's done dead wrong.

Only the exceptional man can stay mentally young and keep those barriers back. But we can all try to keep open and flexible minds by listening to the newcomer's or the youngster's ideas, and by giving them a fair trial, even when we're sure they won't work. Every once in a while, one works—and the world gains a little, the experimenter gains a little, and we gain a little.

George Edwards
*Engineer*

*It is astonishing what you can do when you have a lot of energy, ambition, and plenty of ignorance.* — ALFRED P SLOAN, JR.

# This Check List will help you buy PERMANENT insulating effectiveness

FOR any insulating material to provide maximum fuel or refrigeration savings . . . *and keep on providing them, year in, year out* . . . it must stand up under careful checking with the list at the right. If the materials you are now using do not meet these requirements, you can select a Johns-Manville Insulation that does.

| | | |
|---|---|---|
| **LOW CONDUCTIVITY** | This, of course, is the first thing you look for in insulation. Because Johns-Manville Insulations provide lowest conductivity consistent with strength and other essentials, they assure initial high fuel savings that continue throughout years of service. | ✓ |
| **TEMPERATURE RESISTANCE** | To maintain its original effectiveness, the insulation you use must remain unaffected by the temperatures to which it is subjected. From the complete line of J-M Insulations, you can select the right material for any temperature from 400° F. below to 2500° F. above. | ✓ |
| **CRUSHING STRENGTH** | In locations where it is subjected to compressive loads, the insulation must be able to maintain its strength and true form, even while heated to service temperatures. For such services, the J-M line offers insulating materials with unusually high load-bearing capacities. | ✓ |
| **BREAKING STRENGTH** | Resistance to breaking is important in guarding against damage during transportation and installation. Certain services also demand more than ordinary toughness in insulations. Many J-M materials have unusually high resistance to breaking, as measured by transverse strength. | ✓ |
| **FULL THICKNESS** | For maximum insulating protection, the insulation you use must not sag or compress during application, or deteriorate in service. J-M Block and Pipe Insulations are designed to avoid such dangers . . . and they can be applied without risk of voids or thin spots. | ✓ |
| **MOISTURE RESISTANCE** | This feature is particularly important in refrigeration service, since moisture infiltration causes most low-temperature insulation failures. J-M Refrigeration Insulations offer unusual moisture resistance, and, because of their basically mineral composition, are rotproof and verminproof as well. | ✓ |
| **STABILITY IN SERVICE** | If maximum fuel or refrigeration savings are to continue indefinitely, the insulation you use must not only possess the above characteristics at the start, *it must retain them throughout the life of the equipment on which it is used.* The column at the left gives some brief facts on a few of the many J-M Insulating Materials. | |

### *Check the Characteristics of these J-M Insulating Materials*

**H-T SUPEREX BLOCKS.** For many years the most widely used block insulation for temperatures to 1900° F. Combines high heat resistance and low thermal conductivity. Furnished 3″ to 12″ wide; 18″ and 36″ long; from 1″ to 4″ thick.

**L-W SUPEREX BLOCKS AND PIPE INSULATION.** New-type Superex Block and Pipe Insulation for temperatures to 1500° F. Light in weight, high in insulating efficiency, unusually resistant to compression and breaking. Pipe Insulation in all sizes. Blocks same sizes as H-T Superex.

**ASBESTO-SPONGE FELTED SHEETS AND PIPE INSULATION.** For temperatures to 700° F. where maximum efficiency, salvage value and resistance to vibration and abuse are essential. For outdoor lines, pipe insulation furnished with waterproof jacket. Sheets 6″ to 36″ wide; 36″ long; ½″ to 4″ thick. Pipe Insulation in all standard sizes.

**J-M 85% MAGNESIA BLOCKS AND PIPE INSULATION.** Long recognized as the standard material for temperatures to 600° F. Maintains its high insulating efficiency through years of service. Blocks 3″ to 12″ wide; 18″ or 36″ long; 1″ to 4″ thick. Pipe Insulation in all standard sizes.

**J-M ROCK CORK SHEETS AND PIPE INSULATION.** For cold-storage rooms, refrigerated equipment and piping. Basically mineral, it can't rot, won't harbor vermin or support mold. Highly moisture-resistant, stays permanently efficient in service. Sheets 18″ wide; 36″ long; 1½″ to 4″ thick. Also furnished as lagging and pipe insulation.

**SIL-O-CEL C-22 BRICK.** Insulating refractory for temperatures up to 2000° F. Heat-storage capacity less than ⅓ that of firebrick; is 3 to 4 times more effective in preventing transmitted heat loss. Crushing strength—700 lbs./sq. in. Standard firebrick sizes and shapes.

**JM-20 BRICK.** New-type insulating-refractory brick for temperatures up to 2000° F. Unusually light in weight (1.9 lbs. per standard 9″ equivalent). Standard firebrick sizes and shapes.

**FOR DETAILS** on the complete line of J-M Insulating Materials, write for Catalog IN-55A. Johns-Manville, 22 East 40th St., New York, N. Y.

## Johns-Manville INDUSTRIAL INSULATIONS

*For every temperature . . . for every service*

"MEGGER"
TRADE MARK REGISTERED U.S. PAT. OFF.
Insulation Testers, Ground Testers and Ohmmeters

*In Stock . . .*
*for the Protection of Your*
ELECTRICAL EQUIPMENT

We have, in our Philadelphia warehouse, a large stock of "Megger" instruments for measuring Insulation Resistance, Ground Resistance and Conductor and Contact Resistance.

*Write for descriptive Catalogs 1550-P and 1645-P.*

James G. Biddle Co.
1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

## PF Correction

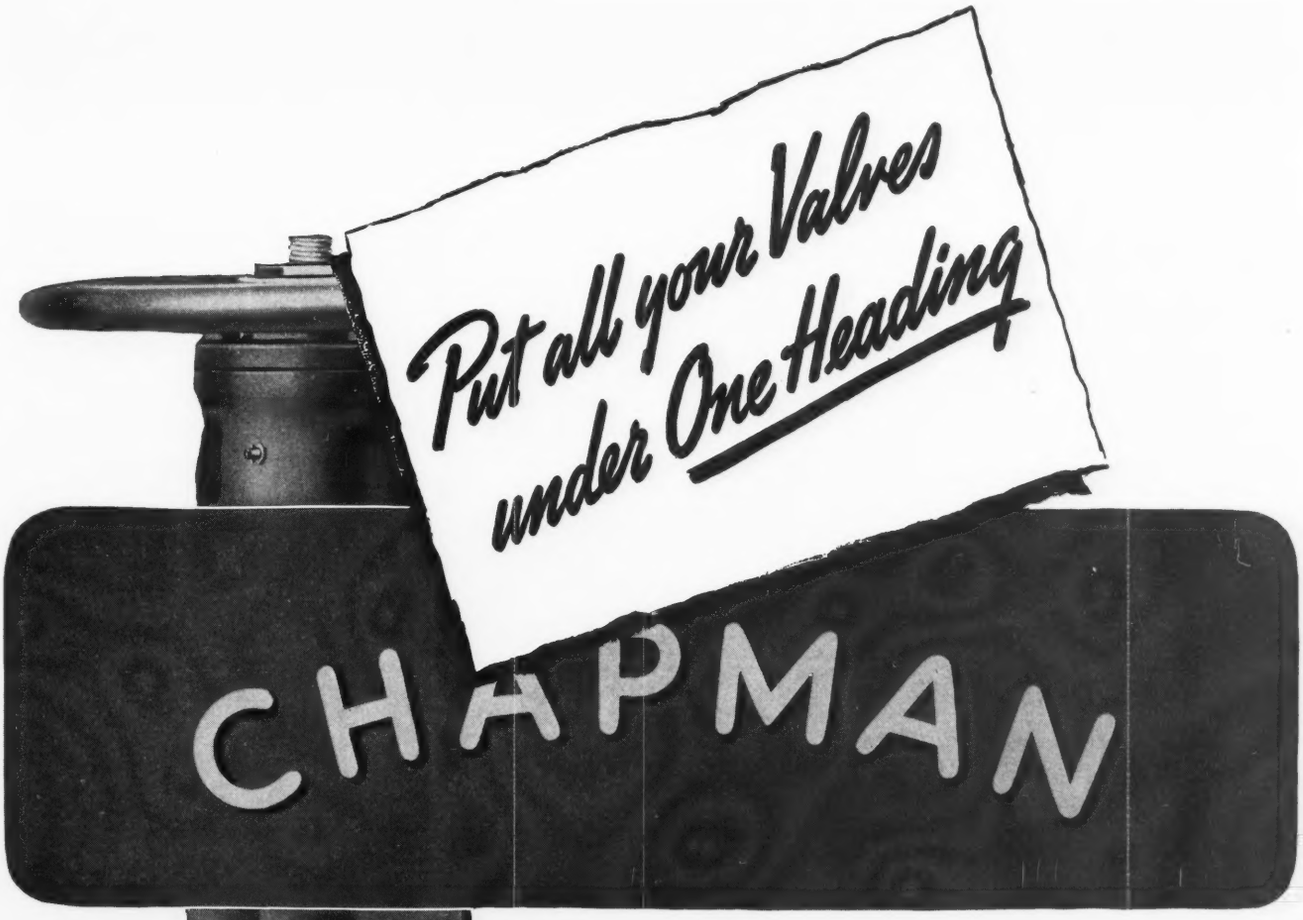
*(Continued from page 66)*

trary to what may be expected, maximum leading kva obtainable from a synchronous motor does not always give maximum power-factor correction. Assume a system load of 2000 kw at 0.66 power-factor, making the system load equal to $2000 \div 0.66 = 3030$ kva. Let us add a 400-hp, 80%-pf, 402-kva synchronous motor to the system and see how it should be operated to give maximum power-factor correction.

This problem can be solved by a simple diagram, Fig. 8. First lay off the kilowatt load to scale along a horizontal line at AB. For example, assume that the scale is to be 100 kw or kva to the inch. Then line *AB* would be 20 in. long. Power-factor is the cosine of the angle of lead or lag between volts and current in a circuit. But forget all about this and just consider power factor and angles as given in the table. Here a 0.66 power factor corresponds to an angle of 49 deg. Then we lay off the kva line *AO* in our diagram to make an angle of 49 deg with the kilowatt-load line. The kva load equals 3030 and, as we are using a scale of 1 in. equals 100 kva, line *AO* will be made 30.3 in. long. Then draw *OB* and if our layout is accurate points *O* and *B* will be in the same vertical line and the line correcting them will represent to scale the reactive kva load on the system.

The motor is to be added to the system to obtain maximum improvement in system power factor; therefore, we will assume it is to be operated at 110% of rated kva or $402 \times 1.1 = 442$ kva. On the scale we are using 442 kva equals 4.4 in. With this distance as a radius and *O* as a center draw an arc as in Fig. 8. Draw line *AC* tangent to the arc and *OC* at right angles to *AC* as shown. To get the new power-factor at which the system will now operate all we need do is to measure angle $\theta_1$, with a protractor, which in this case is 40.5 deg. In the table, 40.5 deg corresponds to a power factor of 0.76.

One might expect that if the motor is operated as a synchronous condenser, maximum power-factor correction would be obtained. This would add reactive load *OF* to the system, if it were possible to operate the motor that way. Then the load on the system would be represented by the line *AF* and the power factor by angle $\theta_2$, which is 43 deg. This angle corresponds to a power factor of 0.73. Under the combination of system and motor loads in the dia-



Every valve requirement—for handling up to 1000° F and 2500 lbs. pressure—can be satisfied completely under a single heading—Chapman. For Chapman offers you gate, globe, check and angle valves—manually or motor operated—in sizes for all applications.

Moreover, by standardizing on Chapman you reap the benefits of Chapman's metallurgical developments—carried out right in their own plant. You get valves—made with precision workmanship—of Chapman-poured bronze, iron, steel, as well as Chromium, Nickel, or Molybdenum alloys—the best metals always for each specific application.

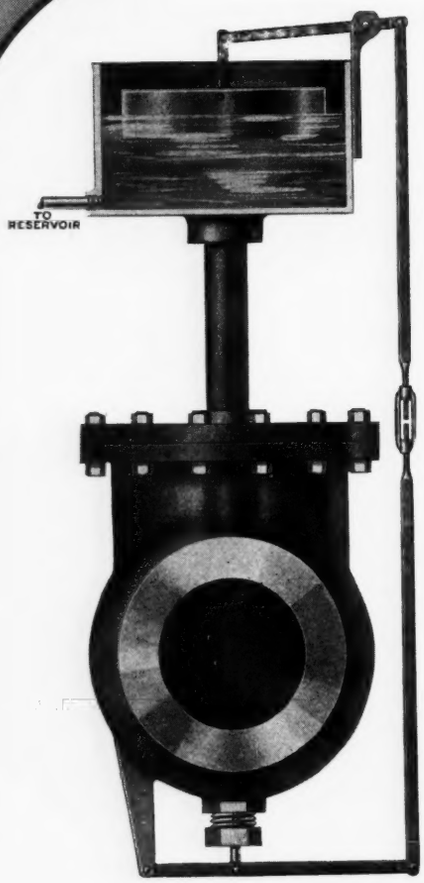
Write for our recommendations for any specification.

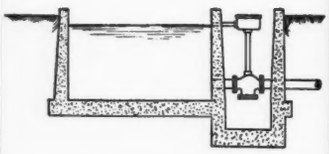
*The* **CHAPMAN VALVE MANUFACTURING CO.**
***Indian Orchard, Massachusetts***

**CHAPMAN**
***Power Plant Valves***

GOLDEN-ANDERSON

Specialty VALVES



FLOAT CONTROL

● Especially practical and desirable for water level control in mixing chambers, coagulating basins, etc., is the G-A Balanced Controlling Float Valve. It *insures* a maximum water level and a constant rate of flow. In the closed position, this valve will seat absolutely tight, and it is cushioned to overcome any shock or surge. Provided in 3" to 24" sizes, this G-A all-around efficiency valve has flanged ends with iron body and bonnet and bronze trim. Complete and detailed information on the entire G-A line may be had upon request. Write for our latest free catalogs today.

*also*

***Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves etc.***

**Golden-Anderson Valve Specialty Co.**

Fulton Bldg. • • • Pittsburgh, Pa.

gram, the same amount of power-factor correction would be obtained when the motor is operated near unity-power-factor and 100% mechanical load as when it is operated as a synchronous condenser.

Many other considerations are involved in the economics of power-factor correction, but this article shows there is a limit too how synchronous motors may be applied. When in doubt refer to the motor manufacturer, a power company representative or a consulting engineer.

## Unit Heaters

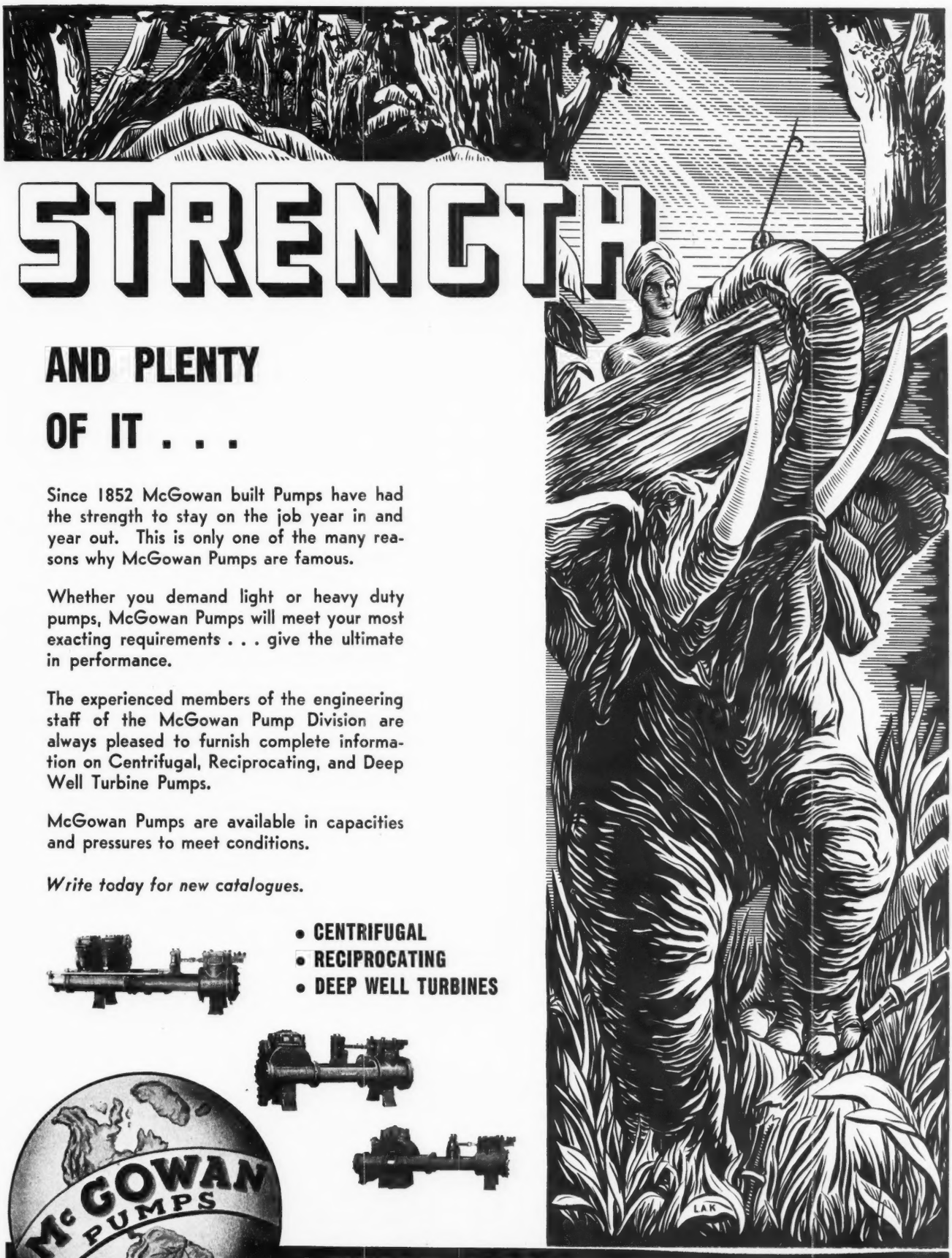
*(Continued from page 74)*

ceiling differential to a minimum. A typical unit consists of a steel housing carrying an extended-surface heating element. The fans draw air over this surface and discharge through hooded outlets which control height and direction of air stream. Where floor space is not available, similar units may be wall mounted in either an upright or inverted position. Units with equipment disposed horizontally may be suspended from the ceiling.

Heating elements fall into two general classes: return-bend units with both inlet and return header at the same end, or straight-tube units with headers at opposite ends. Tubes are usually copper, with copper, brass or aluminum fins; headers may be tubular or cast, non-ferrous or ferrous. The sketch shows two special tube constructions. In one, the heating surface consists of a number of finned pipes, independent of each other, but tied to a single header divided into two parts. Steam enters an inner tube and flows out to the end of the finned condensing tube; condensation returns to the appropriate part of the header.

In the second case, a distributing tube reduces the possibility of a freeze-up when steam quantity is reduced and entering air is below freezing temperature. The distributing tube consists essentially of two half-round tubes with orifices along the length. Steam from the supply header passes through one of these tubes and through the orifices to the condensing tube. The second half-round tube receives excess steam from the first tube at the return end and reverses the distribution toward the supply header.

Centrifugal fans mount on a single shaft, which may be either belt or direct driven. They are multiblade units designed for low tip speed and



# STRENGTH

## AND PLENTY OF IT . . .

Since 1852 McGowan built Pumps have had the strength to stay on the job year in and year out. This is only one of the many reasons why McGowan Pumps are famous.

Whether you demand light or heavy duty pumps, McGowan Pumps will meet your most exacting requirements . . . give the ultimate in performance.

The experienced members of the engineering staff of the McGowan Pump Division are always pleased to furnish complete information on Centrifugal, Reciprocating, and Deep Well Turbine Pumps.

McGowan Pumps are available in capacities and pressures to meet conditions.

*Write today for new catalogues.*



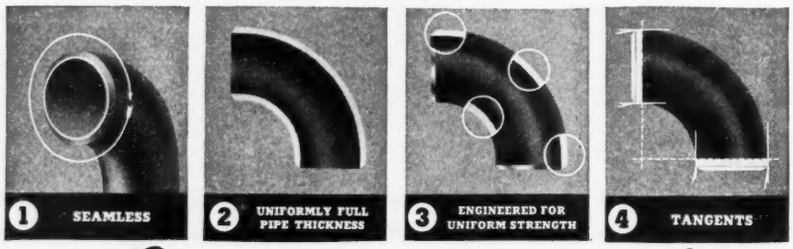
- CENTRIFUGAL
- RECIPROCATING
- DEEP WELL TURBINES

**LEYMAN MANUFACTURING CORP.**

*The* JOHN H. McGOWAN *Co.* DIVISION

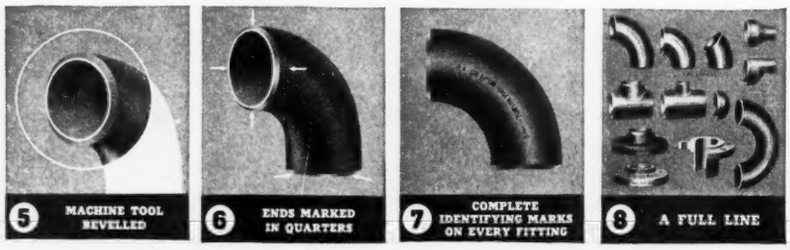
54-58 CENTRAL AVE., CINCINNATI, OHIO

TAYLOR FORGE




*On your next job*

**make the acquaintance of the only welding fittings that offer you all these 8 aids to faster, easier welding**




WeldELLS

Seamless Pipe Fittings for Welding

TAYLOR FORGE & PIPE WORKS

General Offices and Works: Chicago, P. O. Box 485

New York Office: 50 Church St.

Philadelphia Office: Broad Street Station Bldg.


quiet operation. Because these fans can work against resistance, these unit heaters can be arranged to discharge into duct work, where this is desirable for better distribution.

The sketch also shows a centrifugal-fan unit heater fitted with a decorative case, designed for use in offices, lobbies and corridors, and reception rooms. A future article will cover selection, location, piping and control of various unit-heater types.

## New Plant Equipment

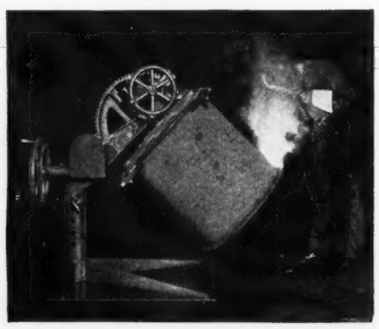
*(Continued from page 124)*

enough to establish desired haze. It is said that Robot-Eye, will, in average natural draft installation, automatically maintain, within 1%, maximum desirable $CO_2$ content in flue gases that burner system will develop without smoke.

*General Power Plant Corp, 512 Fifth Avenue, New York, N. Y.*

### Welding Positioner

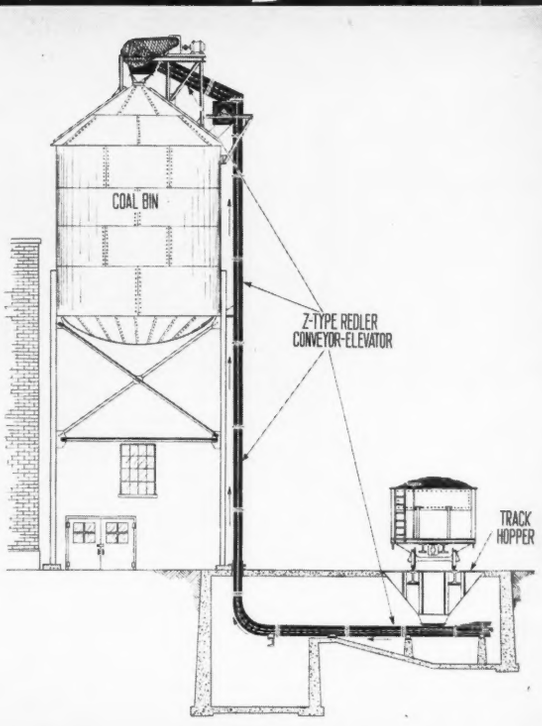
MODEL 12 positioner is new model recently added to present line. Similar to other units in line, unit can be tilted a total of 135 deg from horizontal and can be revolved through a full circle, regardless of angle of tilt. Table is removable for



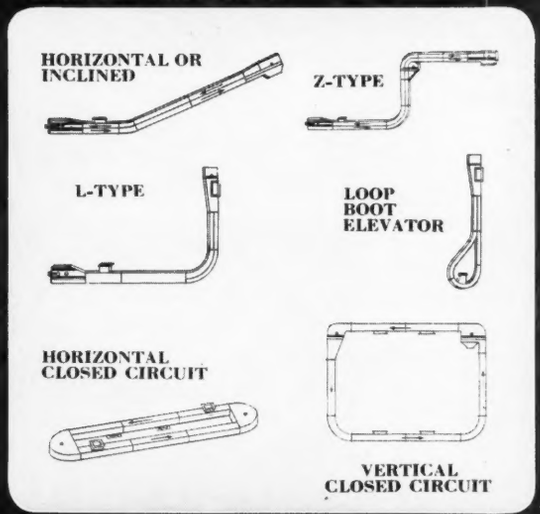
attachment of special jigs or fixtures and is adjustable in height. New unit can be furnished fully-powered with independent motor and controls for table tilt and rotation. Power for table rotation can be furnished with either constant or variable-speed drive.

*Cullen-Friestadt Co, Chicago, Ill.*

# Are You Using Too MANY CONVEYORS ??




● A single REDLER conveys the coal horizontally, vertically, and on incline at one of the plants of Colgate-Palmolive-Peet Co.




● REDLERS are available in standard sections to convey in practically any required direction, in a single unit. Note how the duties of two, and in many cases three, old style Conveyors and Elevators are combined into a single REDLER.

## Find Out How One REDLER CONVEYOR-ELEVATOR Does the Work of Several Old Style Units . . .

**When you use REDLERS, one unit frequently takes the place of as many as three old style Conveyors and Elevators. The single REDLER conveys not only on horizontal and vertical runs, but even around bend corners.**

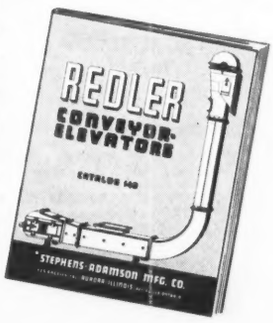
**REDLERS also:**

1. **Are enclosed and dust-tight. They convey-elevate without letting dirt escape from the sealed casing.**
2. **They are compact, requiring only ¼ to ½ the usual space.**
3. **They operate without need for Feeders of any kind, thus eliminating this original equipment and operating expense.**
4. **They are assembled in standard sections at the factory and quickly and easily placed together on the job, at minimum cost.**
5. **Deep Elevator pits are eliminated, through the self-feeding feature.**

***Why not check into the savings of REDLERS for your particular coal handling requirement?***

**FIND OUT FROM NEW REDLER DATA BOOK HOW REDLERS CAN BRING *YOU* THE ABOVE ADVANTAGES:**

**Just off the press, this 64-page REDLER engineering handbook, completely new, shows phantom drawings of all types of REDLERS, with specifications and dimensions. Also detailed H.P. information. Is fully illustrated. *Write for your free copy today!***




●

## STEPHENS-ADAMSON MANUFACTURING COMPANY

5 Ridgeway Ave.

Los Angeles, Cal. AURORA, ILL. Belleville, Ont.

ENGINEERS SA MANUFACTURERS

**"IT COSTS LESS PER TON THE S-A WAY!"**

*Conveying • Elevating • Screening • Transmission Equipment*

JUST A FEW MINUTES NOW AND YOU'LL BE AS GOOD AS NEW

**About 99% of valve wear comes on the seat rings or discs. When they're worn, the rest of the valve is usually as good as new.**

**Then doesn't it strike you as absurd and wasteful to throw away an *entire* valve merely because a small, inexpensive part is worn out?**

**Fairbanks RENEWABLE Valves eliminate this big waste. If a leak develops, you simply remove the worn seat ring or disc and slip in a new one. The whole operation takes only a jiffy. You don't even have to remove the valve from the pipe line or disturb the covering.**

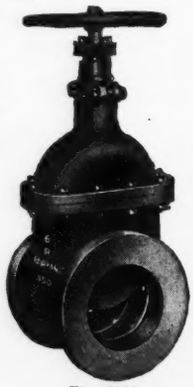


Fig. 0302
150 lbs. steam pressure

**And the cost is only *cents* compared with *dollars* for a whole new valve. In addition, this saves the time, trouble and expense of removing non-renewable types from the pipe line and does away with costly shut-downs.**

**Why not stop this deplorable waste now by replacing your worn valves with Fairbanks "Renewables"!**

**Write for catalog No. 21 and name of our nearest distributor.**

THE FAIRBANKS COMPANY

*Valves, Dart Unions, Hand Trucks and Wheelbarrows*

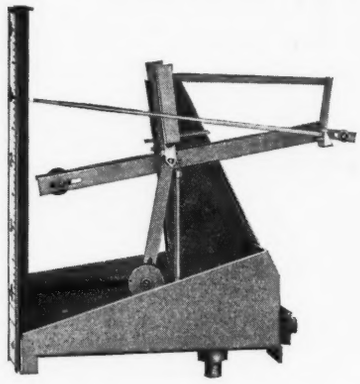
396 Lafayette St., New York, N. Y.

Boston, Pittsburgh—Distributors in Principal Cities
Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks Renewable Valves

## Diaphragm Gage

ELLISON straight-line diaphragm gage has high-power, free-floating diaphragm located on bottom of casing, suspended through ball joint from knife-edge eyelet bearing. For minus pressures, draft line connects with bottom of diaphragm casing, connecting rod passing through top of casing. For plus pressures, draft line

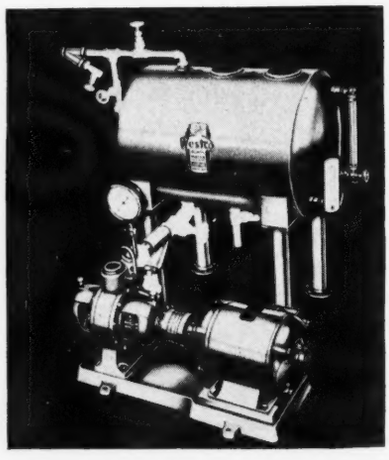


connects with top of diaphragm casing, connecting rod movement operating through the bottom by means of metal link around casing. For differential pressures, draft line connects with top of diaphragm casing for high absolute pressure and with bottom for low. Differential is simplified system for transmitting movement directly to beam, consisting of piece of flexible piano wire moving through a substantially air-tight babbitt sleeve.

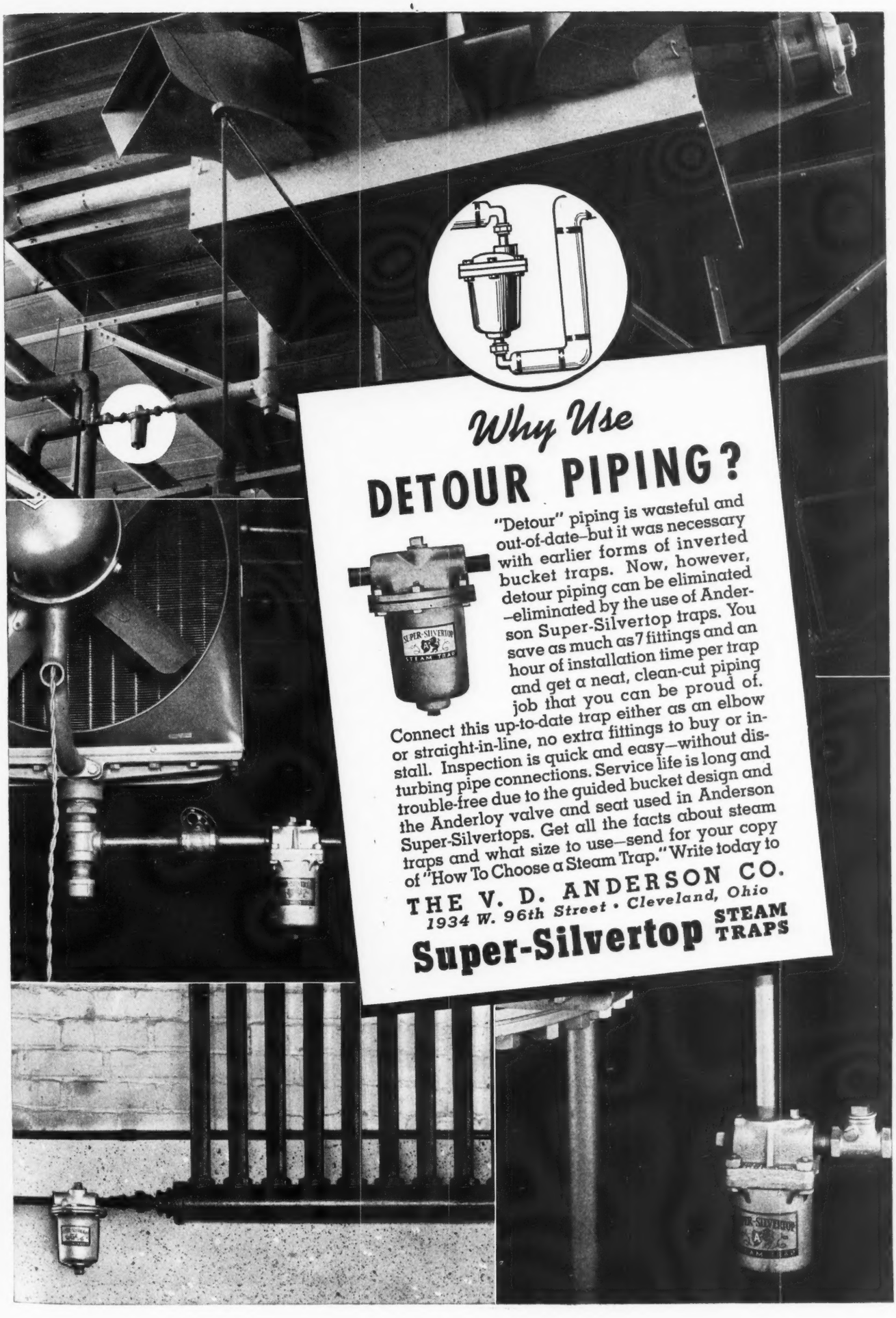
*Ellison Draft Gage Co, 214 W Kinzie St, Chicago, Ill.*

## Boiler-Feed Systems

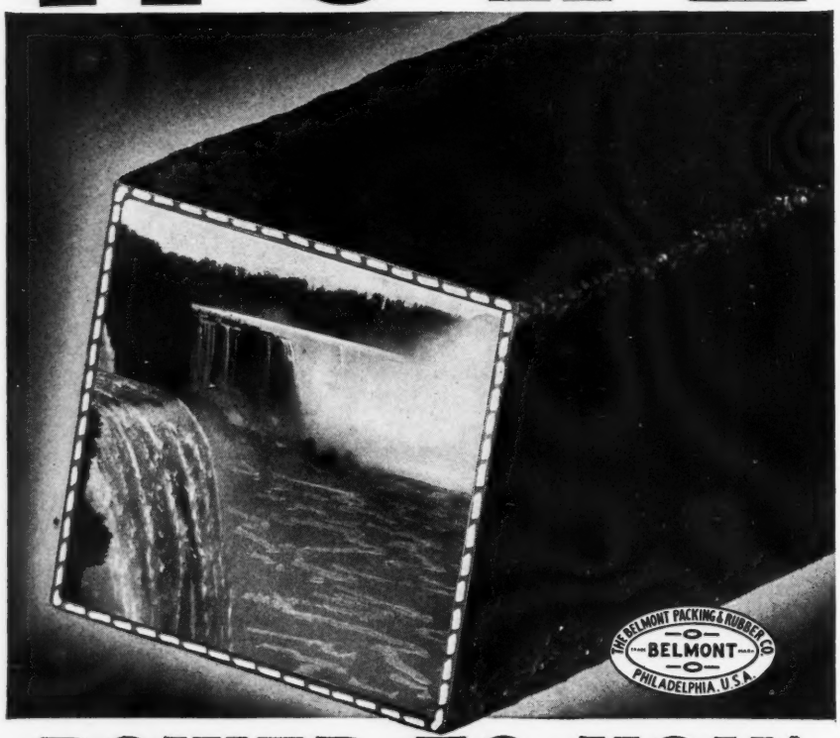
WESTCO automatic boiler-return systems designed for boilers up to 1500 sq ft heating surface and 200 lb pressure. Systems are said to return automatically all condensate to boiler from both high- and low-



pressure equipment, and make-up water as needed to compensate for loss of live steam, maintain a uniform water level in boiler, keep return lines constantly open, eliminate backpressure on return lines, and feature low cost operation. Each combination equipped with Westco turbine pump with renewable liners, and automatic boiler-water-level control, which starts and stops


Why Use
DETOUR PIPING?
"Detour" piping is wasteful and out-of-date—but it was necessary with earlier forms of inverted bucket traps. Now, however, detour piping can be eliminated—eliminated by the use of Anderson Super-Silvertop traps. You save as much as 7 fittings and an hour of installation time per trap and get a neat, clean-cut piping job that you can be proud of.
Connect this up-to-date trap either as an elbow or straight-in-line, no extra fittings to buy or install. Inspection is quick and easy—without disturbing pipe connections. Service life is long and trouble-free due to the guided bucket design and the Anderloy valve and seat used in Anderson Super-Silvertops. Get all the facts about steam traps and what size to use—send for your copy of "How To Choose a Steam Trap." Write today to
THE V. D. ANDERSON CO.
1934 W. 96th Street • Cleveland, Ohio
Super-Silvertop STEAM TRAPS

# MORE




# POWER TO YOU!

## *PACK WITH BELMONT*

No matter how small—power leaks are costly. That's why Belmont takes such minute care in the construction of Belmont Hydraulic Packings.

Take Belmont 319, for example. Only the finest quality rubber friction duck is used. The hollow center, which was originated by Belmont, provides a point of least resistance for contraction and expansion. This also serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole," as varying pressures are exerted upon it in the stuffing box.

This type of construction care is not an isolated example. It's the rule for the entire Belmont Line. See for yourself. A request on your company letterhead will bring the new 1940 edition of the Belmont Catalog to you absolutely free.

**SUGGESTED PACKINGS FOR WATER SERVICE**

**BELMONT 319**

***Hollow Center Packing***

Made of finest quality closely woven rubber frictioned duck, wrapped on itself and moulded to size. Supplied in packing space sizes ¼" and over; lubricated and graphited unless otherwise specified.

**BELMONT 9**

***Special Hydraulic Packing***

Made of Long Line best quality Flax stitched with strong linen thread into a moulded rubber and duck channel. The double combination of casing and flax makes two packings in one against the wearing surface. Supplied lubricated and graphited unless otherwise ordered, in all packing space sizes from ¼" upward.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

# BELMONT

PACKINGS

THE BELMONT PACKING & RUBBER COMPANY

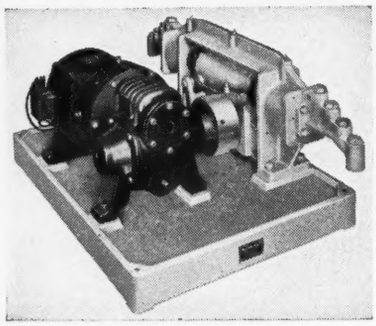
BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.


the boiler-feed pump to maintain water level in boiler, cuts off oil burner or stoker if level in boiler goes too low for safety, and sounds an alarm when low-water cut-off point is reached.

*Micro-Westco, Inc, 104 State St, Bettendorf, Iowa.*

## Chemical Pump

OPPOSED-TYPE duplex chemical pump has capacity of 4 gallons per hour against pressure of 3000 lb. Step-valve construction not only eliminates air binding, according to maker, but also automatically discharges small particles of dirt and makes pump



self-cleaning. Duplex pumps of this type can be furnished to pump against pressures up to 20,000 lb and are recommended for handling alkalis, oil solutions, sulphuric-acid concentrations, chlorine solutions, hypochloric and phosphoric acids.

*Milton Roy Pumps, 2031 E Madison St, Philadelphia, Pa.*

## Trap

DISCHARGER is essentially positive-acting trap designed to handle large quantities of condensate or carryover at relatively high pressures. Discharger, by means of pilot valve, applies steam line pressure to open discharge valve. Displacement weights of different densities move pilot control valve. When pilot has opened, steam is admitted to top of main valve piston, opening discharge valve. Drains are discharged from bottom of body through eduction pipe to outlet. Typical applications are to boiler dry drums, steam purifiers and separators, etc.

*Cochrane Corp, 17th & Allegheny Aves, Philadelphia, Pa.*

## Roller Bearing

MODIFIED design of standard NA type, or non-adjustable roller bearing, is made up of a double-row outer race or cup and two single-row inner races or cones. Unit is especially designed to serve as a sheave bearing. Races and rolls are ground to established precision limits so that when cones are assembled into cups, front faces of cones contact and proper running clearance is provided. Front cone faces are slotted and chamfered to provide entrance for lubricant to bearing. Tapered races of two rows of rolls being directed one

# POWER Shoulders Larger Responsibility

Squarely on America's industries rests the success of this Nation's ability to thwart any threat to our peace and prosperity. Back of every preparedness step that Industry will take is the need for Power, for without modern power facilities every defense effort becomes futile.

In these conditions, this year's National Power Show assumes added importance. Here, under one roof, engineers can, in one short week or less, see the latest products... discuss needs and problems with engineers in attendance at exhibits . . . view demonstrations . . . discuss, compare, and select the latest and best equipment, materials, instruments, supplies and services for efficient power and steam generation, control, transmission and application.

Here, engineers alert to their responsibilities and opportunities will contact manufacturers to make sure that plant capacity can be increased as fast as required, and avoid production-clogging bottle-necks when prompt deliveries are no longer possible.

Admission is by registration.

More than 40,000 visitors are expected.

Engineers and executives with power interests are invited.

## 14th NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING . .

GRAND CENTRAL PALACE · NEW YORK · DEC. 2-7, 1940

*Management, International Exposition Co.*

691

ADVERTISING PAGES REMOVED

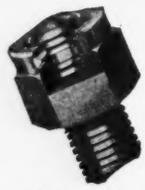
VIBRATION-PROOF!

UNSHAKO

—the NUT that can't shake loose

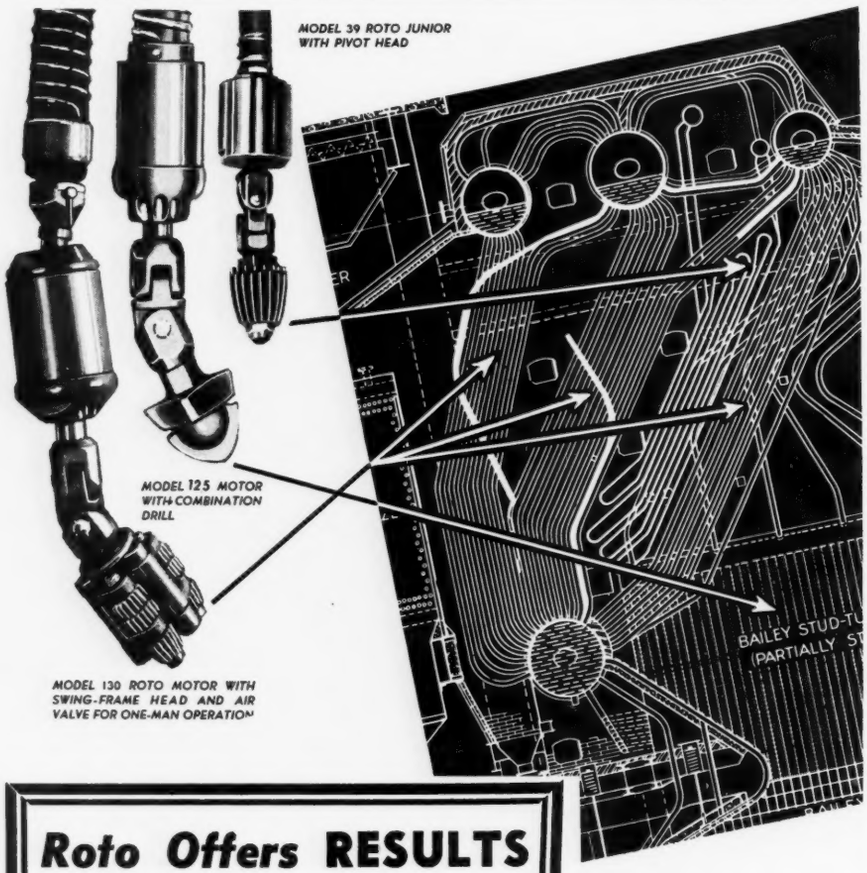
The self-energizing locking ring springs to life as soon as any vibration—no matter how severe—tries to unwind the "Unshako" and positively prevents it.

Order "Unshako", this neatly ingenious and unfailing protection against costly troubles caused by ordinary nuts shaking loose.



Pat'd. and Pat's. Pending

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 577
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO


MODEL 39 ROTO JUNIOR WITH PIVOT HEAD
MODEL 125 MOTOR WITH COMBINATION DRILL
MODEL 130 ROTO MOTOR WITH SWING-FRAME HEAD AND AIR VALVE FOR ONE-MAN OPERATION
BAILEY STUD-TU
(PARTIALLY ST

Roto Offers RESULTS
Not Just Tube Cleaners

Quality construction alone is not enough in tube cleaners. Vitally important, too, is the correct selection of cleaners for each particular job.

Few purchasers have any idea of the extreme care Roto takes in studying each new requirement before completing the sale, especially for the new type high pressure boilers having curved tubes with sharp bends.

Roto is not satisfied merely to supply cleaners that go through the tubes, but strives to furnish the very biggest and most powerful cleaners to assure quick, thorough scale removal.

Roto guarantees RESULTS, not just tube cleaners.

SEE OUR ADV. IN SWEET'S

The ROTO Company
145 SUSSEX AVENUE NEWARK, N. J.

Only ROTO Gives You All These Features

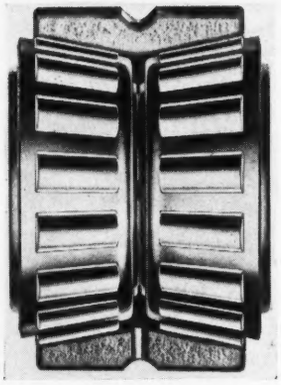
★ makes better use of available air, without back pressure;

★ develops unbelievable speed and power, through new design;

★ air valve directly behind the motor permits one-man operation and eliminates signalling delays;

★ self-feeding cage and swing-frame heads, universal joints and drill have what it takes to do a real job;

★ Available for straight and curved tubes ½" to 12" I.D.

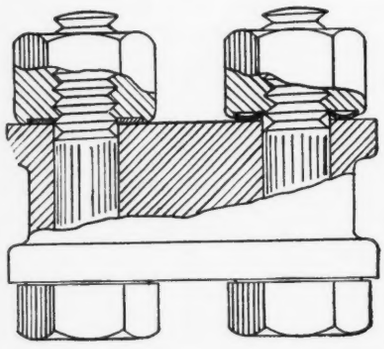


toward other results in bearing of extreme rigidity, thus preventing wobbling of sheave.

*Timken Roller Bearing Co, Canton, Ohio.*

## Lock Nut

AN-COR-LOX is all-metallic, double-chamfered nut made in one unit. Nut is spun on bolt and drawn up to desired torque after it hits work. Soft metal washer expands into root of bolt thread and is com-

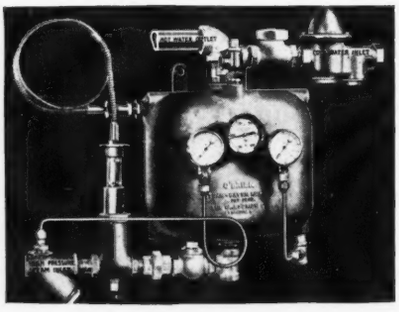


pressed against nut rim, securely locking the nut to bolt, not the work. When unlocking, nuts have high removal torque, makers say, and nuts are made in complete range of sizes and metals.

*An-Cor-Lox Div, Laminated Shim Co, Glennbrook Station, Conn.*

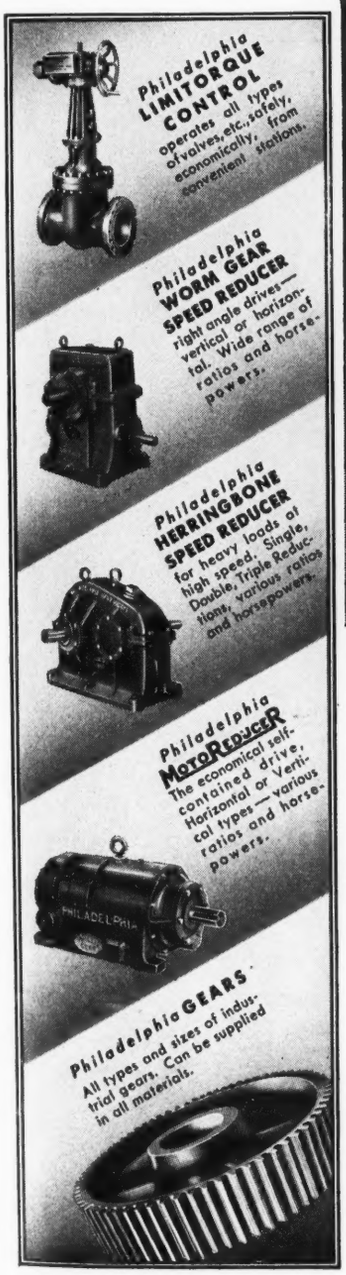
## Steam and Water Mixer

HOT WATER, in amounts up to 3000 gals per hr, furnished by new industrial injection-type steam and water mixing unit.



Three connections necessary: one to cold-water line, another to high-pressure-steam line and third for hot-water outlet. Other

*(Continued on page 148)*


Philadelphia LIMITORQUE CONTROL
operates all types of valves, etc., safely, economically, from convenient stations.
Philadelphia WORM GEAR SPEED REDUCER
right angle drives—vertical or horizontal. Wide range of ratios and horsepowers.
Philadelphia HERRINGBONE SPEED REDUCER
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.
Philadelphia MotoReducER
The economical self-contained drive. Horizontal or Vertical types—various ratios and horsepowers.
Philadelphia GEARS
All types and sizes of industrial gears. Can be supplied in all materials.

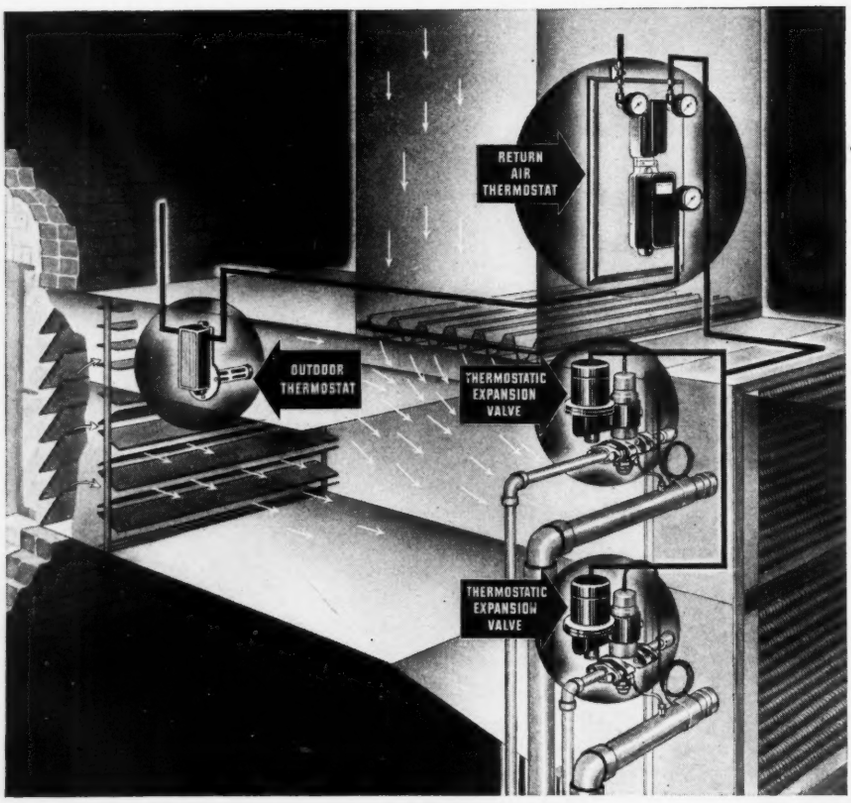
● Naturally, we like orders and are ENTHUSED over repeat business on Philadelphia Speed Reducers . . . They add emphasis to the real engineering and construction Phillie Gear has put into these important machines of industrial production.

Philadelphia Worm Gear Reducers are truly economical and efficient, transmitting a high degree of input power day-in-and-day-out without trouble, and with little if any attention. Where a right angle drive is required, either horizontal or vertical, these units are the answer. Available in a wide range of horsepowers and ratios.

Write for engineering details and particulars.

**PHILADELPHIA GEAR WORKS**

*Industrial Gears and Speed Reducers*
Erie Ave. and G St.
**Philadelphia, Pa.**
•
New York • Pittsburgh • Chicago




# CONTROL INSTRUMENTS RESET AUTOMATICALLY

**RETURN AIR THERMOSTAT** senses the temperature of the air which is recirculated from the conditioned space. The temperature setting of this Remotely Adjusted Thermostat is reset automatically to maintain a required relationship with the temperature at some remote point.

•

**OUTDOOR THERMOSTAT** automatically resets the Return Air Thermostat. This illustrates the use of Johnson remotely adjusted instruments in summer cooling, where a given differential between outdoor and indoor temperature is desired.

•

**THERMOSTATIC EXPANSION VALVES** are fitted with Johnson Modulating Attachments. The remotely adjusted Return Air Thermostat throttles the supply of refrigerant to conform to the cooling load conditions. An exclusive Johnson feature!

## JOHNSON Remotely Adjusted Devices

The Johnson line of remotely adjusted thermostats and humidostats satisfies one more of the definite requirements of the air conditioning and allied industries. This group of instruments is just one more evidence of the ingenious development work and unique design which characterize all of the devices in modern Johnson temperature control systems. The particular application illustrated above may suggest solutions of problems with which *you* have been confronted. Ask for bulletins which describe Johnson remotely adjusted instruments.

**JOHNSON SERVICE COMPANY**
**MILWAUKEE, WISCONSIN**
**DIRECT BRANCHES IN ALL PRINCIPAL CITIES**

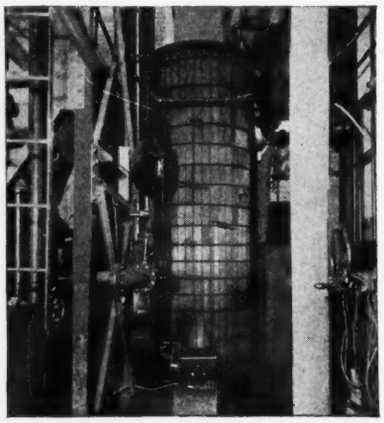
**JOHNSON**
*Automatic* TEMPERATURE AND AIR CONDITIONING *Control*
**JOHNSON CONTROL IS THE "BRAIN" OF THE AIR CONDITIONING SYSTEM**


features listed by maker are: easily accessible clean-out plugs, temperature and pressure relief valves, single-seated steam control valve, and provision for tempering inlet water and recirculating mixer water. Bulletin 840.

*W J O'Brien Co, 205 Harrison St, Syracuse, N. Y.*

## Decarbonator

COCHRANE decarbonator for degasification is used to remove carbon dioxide from effluent of carbonaceous hydrogen zeolite softeners and from water supplies treated with acid. Where soluble iron and carbon dioxide are present in natural water supply,

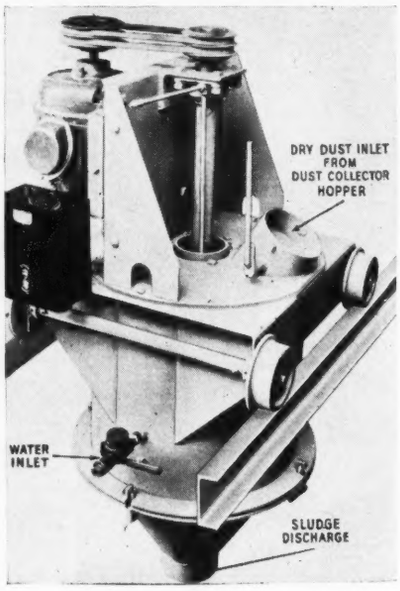


unit removes dissolved carbon dioxide and by aeration oxidizes the soluble iron so that it may be filtered out. Constructed mainly with redwood, unit is equipped with rotary blower and fitted with corrosion-resistant metals.

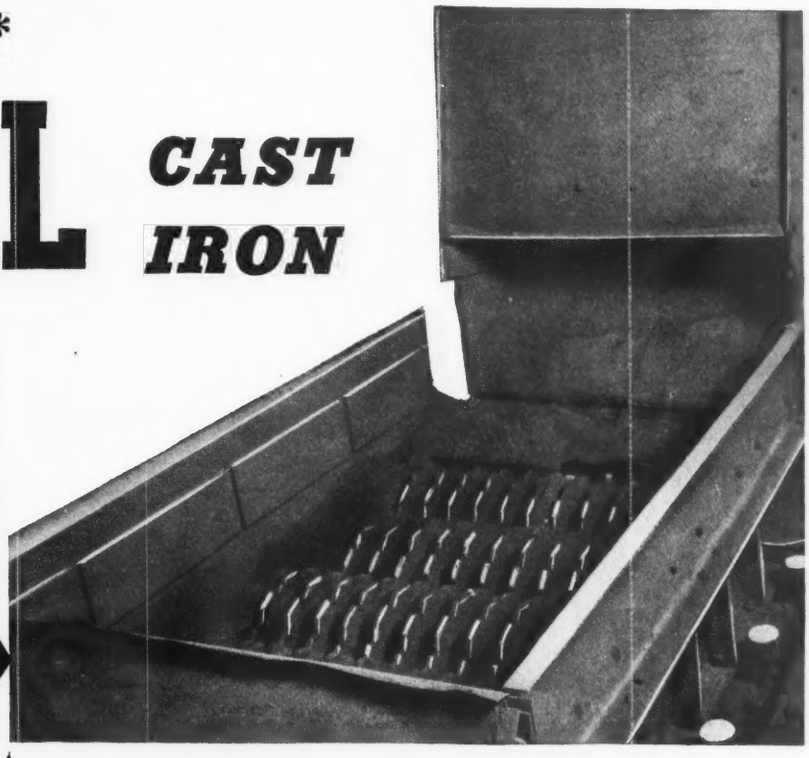
*Cochrane Corp, 17th & Allegheny Aves, Philadelphia, Pa.*

## Dust Disposal Unit

AMERICAN wet disposal unit is designed for wetting and mixing with water or other liquids collected dust discharged from



# NI-HARD* NICKEL CAST IRON



## Outwears
**METALS PREVIOUSLY USED**

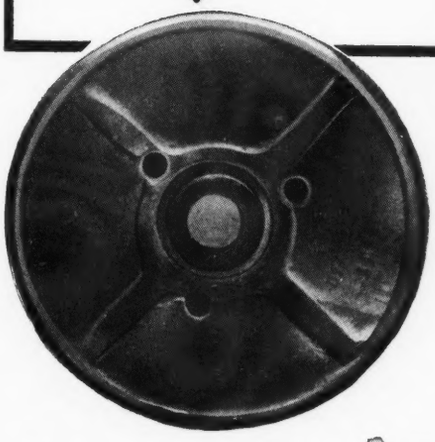
**3 TO 1** *in grizzly discs*

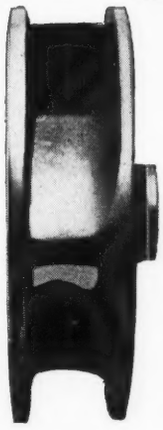
**3 TO 1** *in chute liners*

**4 TO 1** *in sludge pumps*

Ni-Hard is an extremely hard Nickel-chromium cast iron developed especially for severe wear and abrasive applications. Pulverizing coke in the gas plant of the Central New York Power Co., Utica, the Ni-Hard grizzly discs, pictured above, outlasted white iron by more than 3-to-1. These Ni-Hard castings were produced in the foundry of Robins Conveying Belt Co., Passaic, N. J.

You can forget chute liners three times longer, and save repeated replacement costs, by remembering to specify Ni-Hard for new construction or repairs. This abrasion-resistant Nickel-chromium cast iron "stands up far better than previously used materials," says the Hudson Valley Fuel Corporation, Troy, N. Y. The Ni-Hard liner, shown above after nearly half a year's hard service, was cast by the Albany Car Wheel Co.





An Eastern utility pumps ashes half a mile *uphill.* The 8″ impeller shown here, in face and edge views, had handled 37,422 tons of ash...8% solid matter against a head pressure of 85 pounds . . . compared with an average of 11,200 tons for steel impellers previously used. This impeller is "Diamite," a Ni-Hard type Nickel-chromium cast iron produced by Weatherly Foundry and Manufacturing Co., Weatherly, Pa.

*Ni-Hard — Reg. U. S. Pat. Off. by The International Nickel Company, Inc. — Nos. 281, 986.

**Ni-Hard is available from foundries throughout the country. A request from you will bring complete information...promptly.**

## THE INTERNATIONAL NICKEL COMPANY, INC.
**67 WALL STREET NEW YORK, N. Y.**

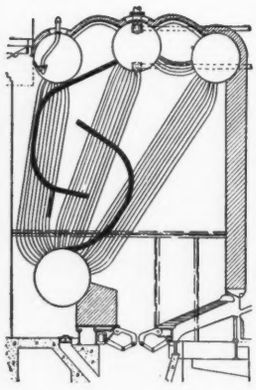
*You are assured of*

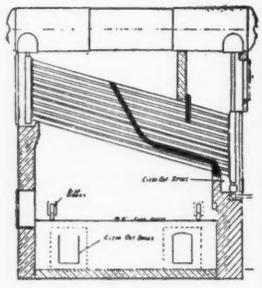
**MORE POWER...**

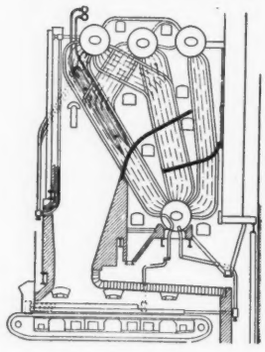
**BETTER BOILER OPERATION**

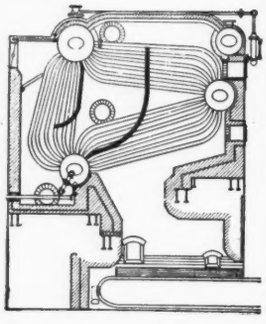
*with*

**Enco Streamline Baffles**









***because:***

. . . they are *designed* to insure better heat distribution, lower flue gas temperatures and higher efficiencies, and the design is based on *results already achieved.*

. . . they are *flexible.* By streamlined and curved construction, it is possible to meet various tube and superheater arrangements and obtain maximum rate of heat transfer.

. . . surfaces are *smoothly curved.* Enco Streamlined Baffles, by eliminating angle joints, eliminate dead gas pockets and eddy currents. By so doing they decrease draft loss and make it easier for soot blowers to do their work more effectively.

. . . they are *gas tight.* Construction work is done by experienced mechanics who are specialists in building baffle walls exactly to Enco specifications. Provision is made in both design and construction for removal of tubes with the least possible disturbance of baffle walls.

. . . *Enco materials are carefully selected.* Only the finest obtainable refractories are used for Enco tile and plastics. Special processing is employed to insure resistance to high temperatures and maximum life in service.

**Ask for Bulletin BW-40**

*Containing Valuable Information*

Detailed engineering data on modern baffle wall practice for all types of water tube boilers—FREE on request.

**THE ENGINEER COMPANY**

75 West St., New York, N. Y.

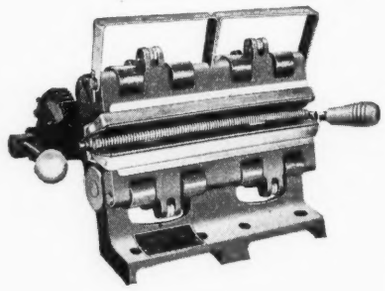

hoppers of cloth-type or other dry types of dust collectors. Unit is self-contained mixer which receives dry dust from collector hopper and deposits it near center of high-speed mixing disk. At same time, water or other liquid is discharged at disk center. Speed and shape of disk cause instantaneous mixing of dust and liquid, and mixture flows from sludge discharge at bottom of unit. Amounts of dust and water are constantly under control of operator, allowing any mixture desired. Unit will handle dust approximately as fast as a hopper can be unloaded dry. In multiple hopper installations, unit would preferably be mounted on a track, and be moved from hopper to hopper as needed. Quick coupling allows rapid connections to regular hopper valve through a flexible canvas spout.

*American Foundry Equipment Co, 581 South Byrkit Street, Mishawaka, Ind.*

## Belt Lacer

SAFETY PORTABLE BELT LACER No. 15 has fifteen inches of ribbed jaw faces that will lace from one to fifteen inches of belt width in one operation. New unit is similar to 6-in. lacer now on market. Lacer will be built on order only and for users of Safety Belt Hooks.

*Safety Belt Lacer Co, Factories Bldg, Toledo, Ohio*



## Wrenches

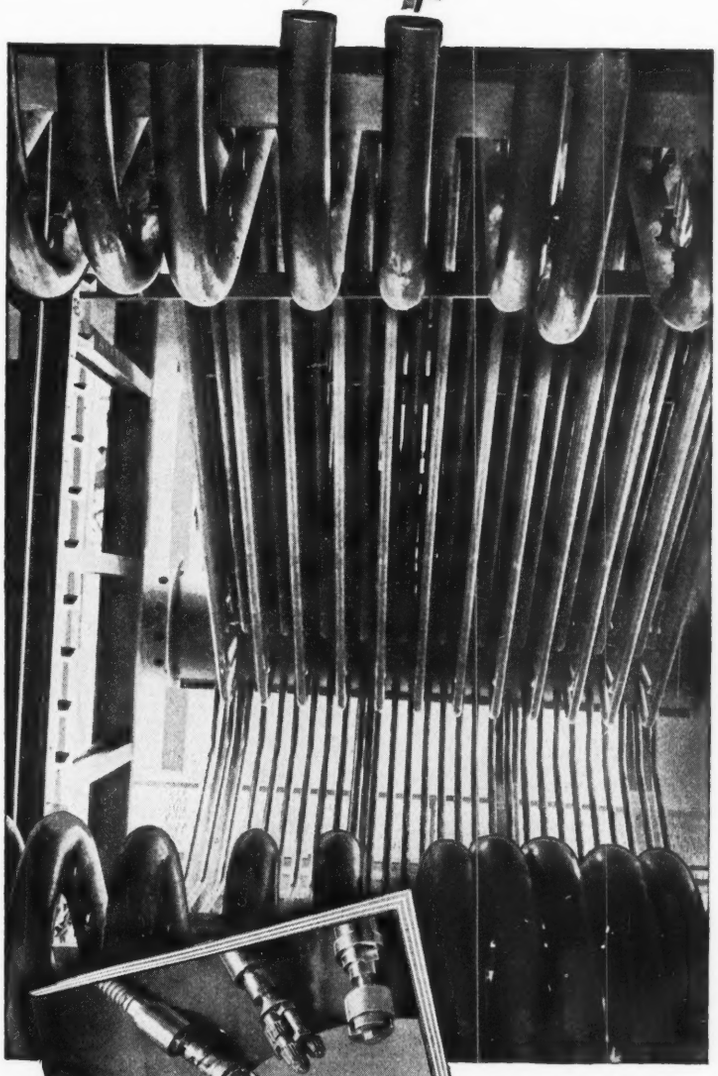
DROP-FORGED open-end adustable wrenches available in 4-, 6-, 8-, 10- and 12-in. lengths, with capacities of $\frac{1}{2}$ to $1\frac{1}{16}$ in. Both handle and jaw are hardened and tempered in oil. Four tapered threads meshing in forged jaw permit great pressure on handle, maker says. Jaws are designed to fit square or hexagon nuts.

*Bonney Forge and Tool Works, Allentown, Pa.*

## Proportioning Feeder

MODEL B FEEDER employs Haering principle for proportioning liquids into liquids or gases, and operates on pressure difference between pitot tubes. Improvements in new model include use of flexible steel tubing on pitot tubes and cross lines to take up stress and shock of water hammer and slight misalignments due to curling of welded connections. Check valve is now installed on needle-valve line where it prevents reagent backing into this line. Both

# WHAT FUN TUBE CLEANERS HAVE!



*Here is a booklet on tube cleaning which will be of interest to every engineer. Write for your copy.*

Y-153

*"Whee!" cries Libby,*
*"I love these steep curves!"*
*"Me, too", yells Larry,*
*"This is play for us."*

Sure, when you love your work, it's fun. And when you're an expert, work is almost play. Curved tubes and steep grades offer no problem to —

## LAGONDA and LIBERTY TUBE CLEANERS

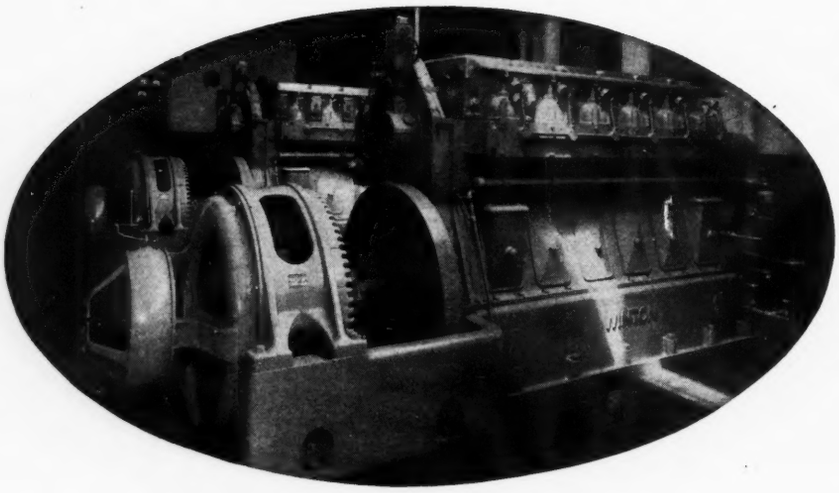
— It's all part of the job.

With almost "Roller - Coaster" speed, LAGONDA-LIBERTY Tube Cleaners eliminate scale, sludge, coke, or anything else which clutters up tubes and pipes in boilers, condensers, heat exchangers and other tubular apparatus. Built in several types—and in all sizes for cleaning small tubes ½ inch I.D. up to sizes for large pipes. Air or water driven.

Bring your problem to Tube Cleaning Headquarters. Our engineers are ready to help you. Write for interesting descriptive literature.

**ELLIOTT COMPANY**
**LAGONDA LIBERTY** *Tube Cleaner Dept.*
**SPRINGFIELD, OHIO**
***District Offices in Principal Cities***

# SERVICE PROVED Lubricants Assure Dependable Performance



Trick oils may look impressive in short demonstrations, but if you want Diesel oils that will give dependable, consistent performance — every day — every week — every month — you will want an oil that has proved its worth. Not an experimental oil but one that has been service proved — a Cities Service oil, engineered for the job.

Experience has shown that no one oil will prove most effective and economical for a given make of engine under all conditions of operation. Such factors as power output, crankcase oil temperatures, etc., may as often as not make the use of a cheap oil expensive and an expensive oil cheap. Let one of our lubrication engineers tell you why — and prove it on your own equipment. Mail the coupon to us or write us on your own letterhead.

In any event you will benefit from reading a copy of our new booklet on "Diesel Engine Lubrication." Sent free to any user of Diesel engine oil.

CITIES SERVICE DIESEL LUBRICANTS

CITIES SERVICE OIL CO.
SIXTY WALL TOWER—Room 1626A,
NEW YORK, N. Y.

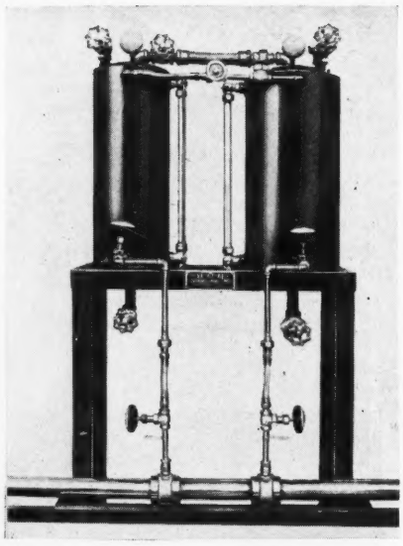
Please send me information concerning your Engineers' Lubrication Service (check box) ☐

Please send me folder on "Diesel Engine Lubrication" ..... (check box) ☐

*Name*_____

*Firm Name*_____

*Address*_____ *City*_____

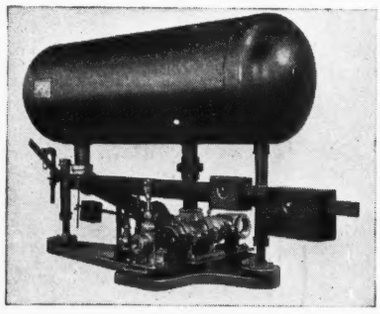



gage glasses are now installed on inside of units facing each other. This is said to protect gages from accidental damage and reduce hazard of, as well as from, gage glass breakage.

*D W Haering & Co, Inc, 2306 S Winchester Ave, Chicago, Ill.*

## Boiler-Feeding and Deaerating System

ACKER SYSTEM deaerates water fed to boilers. Naval bronze female trunnion receives direct support from bearing unit composed of two split bearings cast integral to insure permanent alignment and



located in center of rocker section, thus carrying full load of tilting mechanism. Male steam end and water end are bolted independently on heavy bridged base which holds all elements in alignment.

*W M Acker Organization, Inc, 3167 Fulton Road, Cleveland, Ohio*

## Vibrator

UNITS are fitted with hooks for attachment to bottoms of railroad cars to facilitate unloading coal, etc. They are large pulsating electromagnets striking 3600 times per minute and together with hook weigh 950 lb each. Used in pairs, two to a car on opposite sides, units must be provided with means of handling, such as overhead crane, hoist, etc. Each vibrator comes with separate electrical control panel that contains thermionic valve for changing alternating to pulsating current, operating

## REVERE TECHNICAL ADVISORY SERVICE

In many plants and industries, Revere Technical Advisory Service men are working shoulder to shoulder with executives and engineers in solving defense problems by selecting a suitable type and form of copper or one of the many copper base alloys.

These are picked men, with broad backgrounds in metal-working methods, plus highly specialized knowledge of copper and copper base alloy characteristics and applications. They are supported in this work by the full cooperation of the Revere Research Laboratories and Revere Mills.

This Technical Advisory Service comprises a thoroughly equipped Research Laboratory, manned by engineers and metallurgists for (1) developing new and better Revere materials to meet active or anticipated needs of industry; (2) supplying specific and detailed knowledge of the properties of engineering and construction materials; and (3) continuously observing developments of science and engineering with a view to their utilization in the improvement of Revere production methods and equipment.

In addition a corps of technical men are available to (1) help industrial executives make use of data developed by the Revere research laboratory staff; (2) perceive the material problems existent in industrial plants contacted; (3) assemble data enabling Revere research laboratory men to study these problems; and (4) make practical tests of the materials recommended in the plants concerned.

This Revere Technical Advisory Service set-up has been very successful in reducing costs, improving products and increasing the output for many industrial concerns.

Its service is available to you with no expense or obligation on your part.

Behind the wheels of industry, as it mobilizes for the defense program, there must be dependable power.

Already the power industry itself has been forced to order equipment much earlier than planned.

Revere Copper and Brass Incorporated is prepared for power orders for tubes, condenser plates, bus bar, pipe, tubing and Herculoy—Revere's patented silicon bronze, which is extensively used in pole line hardware and in tanks.

In the past ten years, Revere research, coupled with Revere plant expansion, has put this company in the position of being able to give speedy service on orders for copper, bronze, brass and other copper alloys. We invite you to consult the Revere Technical Advisory Service for assistance in speeding up your output, minimizing your cost and increasing your facilities. Simply write to

# REVERE

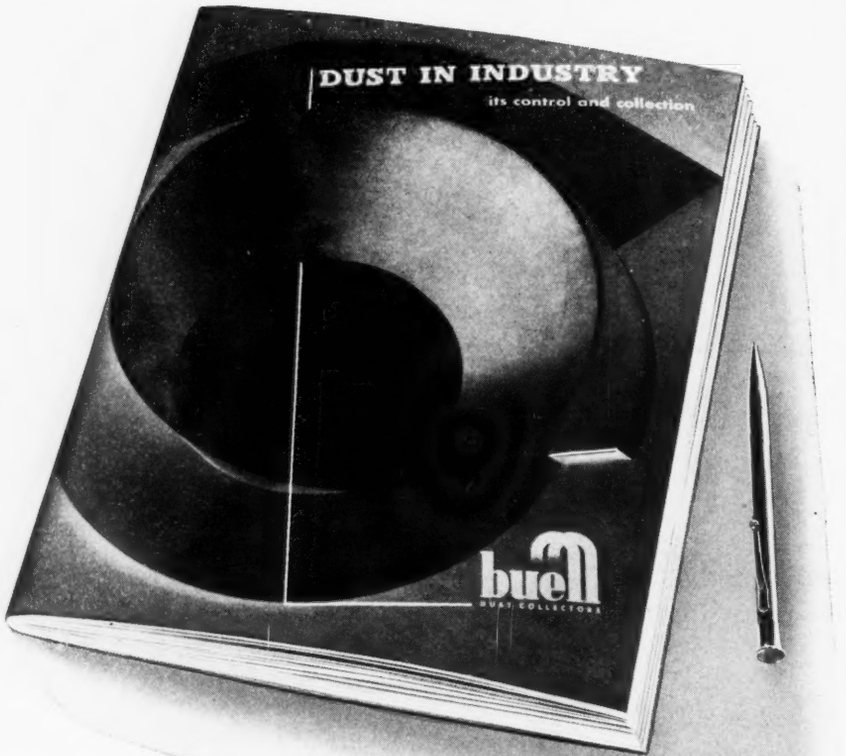
**COPPER AND BRASS INCORPORATED**

*Executive Offices:*
230 Park Avenue, New York, N. Y.

*Sales Offices and Distributors in most of America's major cities*

**MILLS: BALTIMORE, MD. · TAUNTON, MASS. · ROME, N. Y. NEW BEDFORD, MASS. · DETROIT, MICH. · CHICAGO, ILL.**

*Send for your copy of this new book*




This informative, new 24-page book, "DUST IN INDUSTRY" gets "down to earth" on both the theory and practice of dust collection, cites practical examples, offers many valuable suggestions. A copy will be sent any executive or engineer upon request. Just write BUELL ENGINEERING CO., INC., 10 Cedar Street, New York

or B. F. STURTEVANT CO., HYDE PARK, MASS.

buell
DUST COLLECTORS

switches and variable resistance for controlling vibrator's amplitude or power.

*Syntron Co, 492 Lexington Ave, Homer City, Pa.*

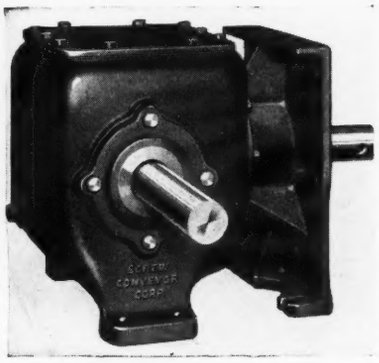
## Engine Cutout

SAFETY DEVICE is designed to protect stationary internal-combustion engines by interrupting operation if lubricating-oil-pressure drops dangerously low, or if cooling-water-temperature rises too high. Available in two models, one with manual reset, and other with automatic reset. For engines with distributor type ignition, device is wired to break circuit on temperature rise or pressure fall. For engines with magneto type ignition opposite terminals are used which short circuits primary of spark coil to ground. For diesel engines device is set up to control a solenoid valve installed in fuel line to injection system.

*Minneapolis-Honeywell Regulator Co, 2747 Fourth Ave, S Minneapolis, Minn.*

## Gear Housing

ACE unit is one-piece enclosed, anti-friction counter-shaft box end. Designed to bring power losses to minimum, as well as to provide protection from fires, accidents, etc. Houses both gears and bearings, is completely sealed from dirt and dust, as well as being oil-leak-proof. Box end is interchangeable with old types and is designed with a safety factor in excess of normal horsepower requirements.



*Screw Conveyor Corp, 744 Hoffman St, Hammond, Ind.*

## Fans

"TEARDROP" propeller has permitted widely increased application of company's adjustable-pitch fan, according to maker. New propeller is said to provide economy in power consumption even when both speed and blade pitch are changed to give exactly amount of air desired.

*Hartzell Propeller Fan Co, Piqua, Ohio.*

## Packing

REINFORCED HYDRAULIC "U" packing is doubly reinforced against wear on contact leg and against pinch from excessive clear-

"NO TROUBLE"

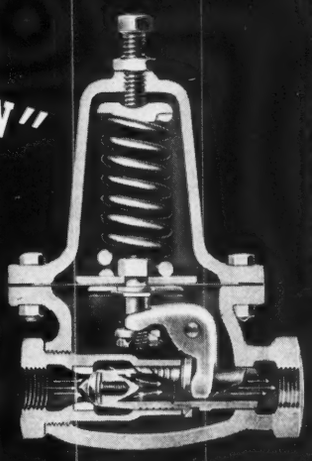
"SPEEDS PRODUCTION"

"STOPS SPOILAGE"

"Dependable"

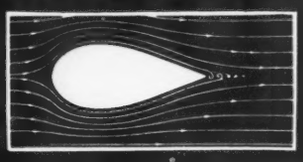
"HIGH CAPACITY"

"No Service Attention"



## REDUCED PRESSURE *Never* VARIES

The streamlined flow offers unusual value to all users. It means no turbulence, just smooth, straight as an arrow flow. You are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. Even though supply line pressure changes or demand changes, you still have smooth action—close, dependable regulation. You experience no spoilage results due to erratic pressure — because the reduced pressure never varies.



## A CASH STANDARD "GET ACQUAINTED" COLUMN

*Question:* "Don't you people make anything besides that Streamlined Valve you talk about so much?"

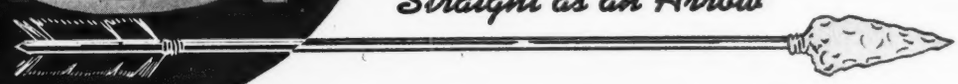
*Answer:* "Yes Sir; we do! And we propose to picture one or two of them here each time."

Straight line flow all the way — straight as an arrow. Look at the phantom streamlined valve at the left — note the housing which contains the inner valve — you could easily mistake this housing for a pipe running straight through—straight as an arrow. We just emphasize in this way the reason why you get the straightline flow in the streamlined type 1000 CASH STANDARD Valves you buy — also it is the reason for such enthusiastic comments by users that you can read on this page.

### VALVE TURBULENCE ELIMINATED

The valve increases performance results by eliminating the ordinary valve turbulence indicated in illustration above. There is no detour around a dividing wall — the direction of flow is not changed at right angles because of a seat wall—also, the flow is not broken up by valve stems, springs, or other parts.

*Straight as an Arrow*



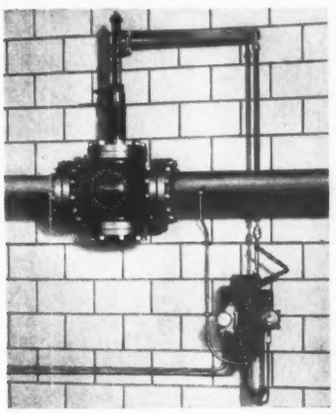
# CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

*give you much more in production results at much less in cost . . .*

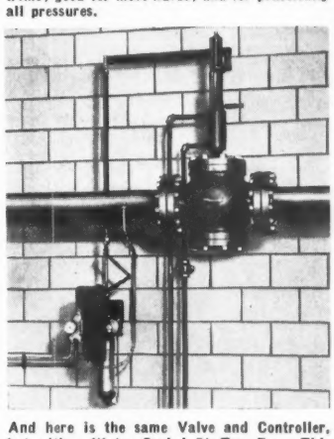
**Up above we say, "No Trouble"—"Speeds Production"—"Stops Spoilage"—"Dependable" — "High Capacity" — "No Service Attention" — then again at the left, experience has much to say—**

**—You can prove all this for yourself by using a CASH STANDARD Streamlined Valve FREE for 30 days. This NO COST trial opportunity is being taken advantage of from far and wide — tell us to ship you one on 30-days free trial. After 30 days you get a bill — you either pay for it then or return valve to us at our expense.**

**READ THE FACTS IN BULLETIN 1000**



A revelation in precision control — the Cash Standard Balanced Lever Valve (Type 42-AC-R) being operated by a Type 100 Controller. Reducing steam at high pressure and high temperature, it has an Air Cooled Stuffing Box. Has valve stem lubricator, valve stem integral with inner valve, roller guides — no lost motion. Sizes: ½" to 12"; all trims; good for most fluids; and for practically all pressures.



And here is the same Valve and Controller, but with a Water Cooled Stuffing Box. This combination could be used for pressure reduction; but it is shown in use for precise back pressure control. Both cuts show a Hand Control Valve on the "100" Controllers. With it, you can interrupt automatic control, and take over control by hand, using the Hand Control Valve lever to manipulate the Balanced Lever Valve as you please, or lock it in any open or closed position you desire.

## ..... IF YOU GO BY EXPERIENCE .....

## You'll Buy the Type 1000

*Read what experience says*

**Our men say — Streamliners are accurate — They never have to be touched —**

"Our men say they specify your Streamlined 1000 Valves because they are accurate, and because they never had to touch one of them since they were installed. I don't see how you could wish for a better report."—Case No. 358.

**Denies having Streamliner — Finds one two years old — Forgot about it because it gave no trouble —**

"I was sincere when I told you we had no Streamlined Valve here because I look after all the Valves. But since you gave me the date and order number I looked into it and all I can say is—You're right. There is one here. But nobody has had to look at it since it was installed two years ago. I'm glad you came back at me because I'm strong for Valves like that."—Case No. 360.

**Lot of Valves — Must be working well — Because no troubles reported —**

"We've got a lot of your Streamlined Valves here and they must be working well because I haven't had a single case of trouble reported on them. When something works well we usually stick to it, so you'll be hearing from us right along."—Case No. 366.

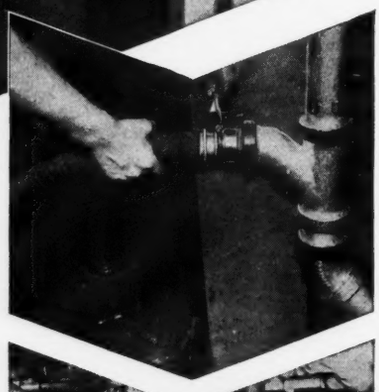
**Wanted dependable Valve — Streamliner stood lab tests — 5 years of plant experience confirm lab test —**

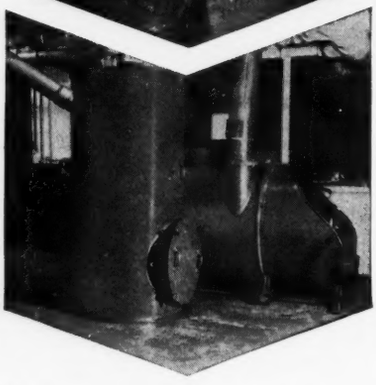
"Bought the first '1000' Valve because we were on the hunt for a dependable Valve. Laboratory tests were so good we standardized on it. Plant use confirmed lab tests. With practically no trouble with any of these Valves over a five year period — we are not on the hunt any more."—Case No. 369.

**CASH STANDARD CONTROLS . . VALVES**

**A. W. CASH COMPANY**
**DECATUR, ILLINOIS**

**Get Free Bulletins on Above . . . Write to**
**A. W. CASH COMPANY**
**DECATUR, ILL.**





# IF YOUR PRODUCT IS *"Built like a Watch"*

you will be interested to know that watch, radio, ceramic and similar industries use Spencer Vacuum Cleaning not only because it reduces cleaning costs, but because it saves on production costs and rejects due to dust as well.

A watch manufacturer says: "Our factory installed two Spencer vacuum cleaning units for cleaning the floors in 1914. These units performed so satisfactorily that a third Spencer installation was specified for our new building fourteen years later.

"Today all three units are doing their daily job. The Elgin National Watch Company is pleased with their Spencer Turbines."

Another large watch manufacturer in the east cleans 180,000 square feet a day with a Spencer and estimates that the original cost will be written off at the end of three years.

Spencer Vacuum Cleaning is fast, effective and economical. It reduces health, fire and explosion hazards, cleans floors, machinery and overhead, and handles all kinds of materials from lint to lead, and sand to sawdust.

If you have bulky or heavy litter in your plant, a trial of the new Spencer 7½ HP (7½ cu. ft. dirt capacity) Portable will convince you without obligation.

The three essentials for heavy duty vacuum cleaning.

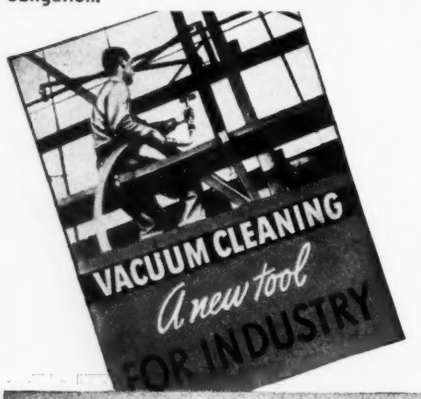
Top: Light weight handles with swivel joint and suitable vacuum tools.

Center: Durable vacuum hose and 2" piping sytem with inlets on each floor leading to—

Bottom: A powerful vacuum producer with separator and dirt receptacle of ample capacity in the basement.

THE BOOK OF EXPERIENCE: What vacuum cleaning is doing in industry as reported by a survey of 444 users of Spencer Vacuum Cleaning Systems ranging from ¾ HP portables to 100 HP stationary systems.

ASK FOR BULLETIN No. 120-P.




182-E

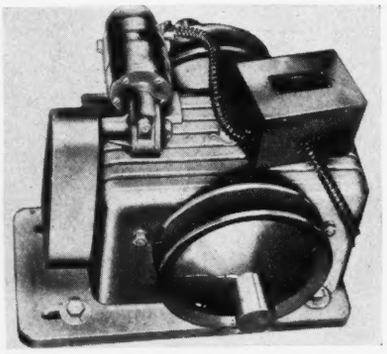
SPENCER HARTFORD
CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS
THE SPENCER TURBINE COMPANY, HARTFORD, CONN.


ance between plunger and gland ring. Standard reinforcement is tough chrome tanned belting leather backed by oak-tanned belting leather stock. Patented phosphor-bronze spring spacer maintains light pressure against inside of bevelled contact lip near its pressure edge. This insures a primary seal until packing lips can be set to plunger surface under pressure so as to carry seal to packing heel.

*Wayne Davies Packings, Inc, 325 West Huron St, Chicago, Ill.*

## Speed Transmissions

MODELS in line supplement standard line from fractional- to 7½-hp capacity controlled with lever type control. New units are equipped with electric motorized control, and are recommended for use where



machinery has to be mounted on ceiling, back or inside of equipment. Two-button switch controls speed. Changes in speed are made simply by pushing and holding either slow or fast button until desired speed is obtained.

*Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.*

## Pump Bearing

BEARING has been created by heavy application of electrolytically-deposited chromium over a monel stainless sleeve which has been swedged into a vertical pump shaft. Process is said to have been perfected for use in deepwell vertical pumps. Pump shaft is armored with heavy chromium over a non-corrosive metal sleeve every 10 feet. These sections of shaft operate within resilient cutless-rubber journals, which are fluted and non-revolvable. Any sand in the water flushes through the bearing. Because of the extreme hardness and thickness of the chrome and its bearing contact with the cutless rubber, no abrasion occurs, according to company engineers.

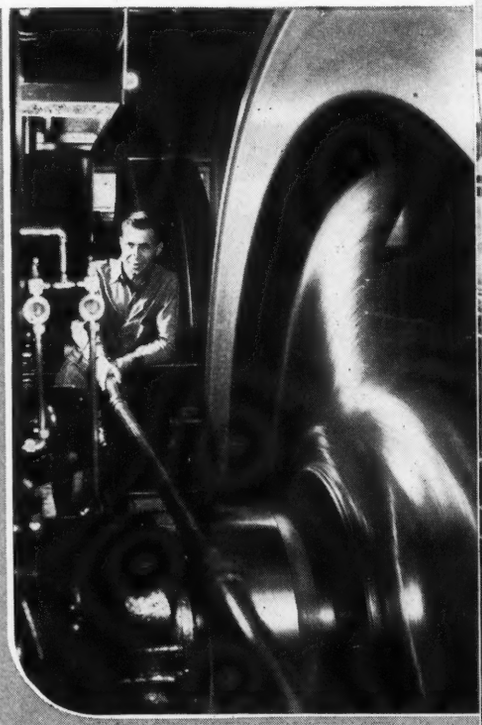
*Peerless Pump Co, 301 W Ave, 26, Los Angeles, Calif.*

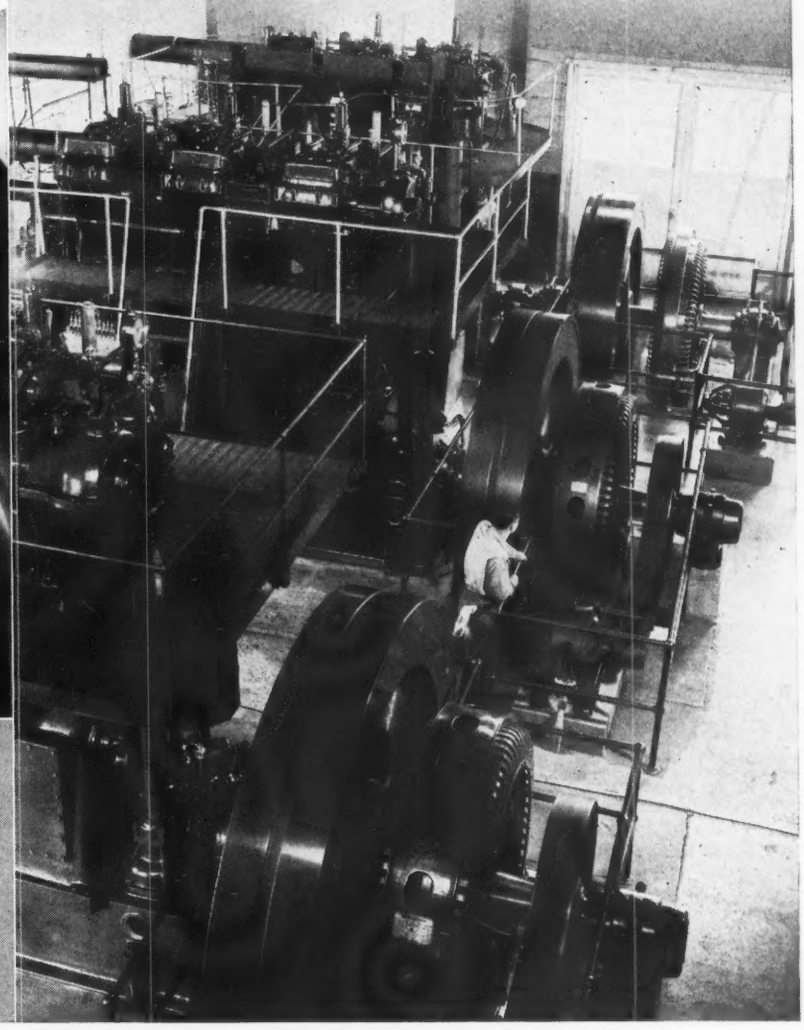
## Air Compressor

COMPRESSOR is stationary model of Fordair Compressor described in New Equipment columns of March, 1940, POWER. Stationary units are complete with built-in cooling systems, electric starting system, including

# "FIFTEEN YEARS OF low operating AND maintenance costs

## IS OUR RECORD WITH GULF PARVIS OIL"... says this Chief Engineer





The Chief Engineer of this large plant credits an enviable operating record in large part to the use of Gulf's higher quality lubricants.

GULF INDUSTRIAL LUBRICATION

# "Actual figures prove the fine results we're getting from GULF PERIODIC CONSULTATION SERVICE"

"THE high quality of Gulf Parvis Oil is, in our opinion, one outstanding reason for our fifteen-year record of low cost operation," says this Chief Engineer. "Our big Diesels are in perfect operating condition today, and we haven't had a liner replacement since we began using Gulf lubricants. We are particularly pleased with the fine condition of the cylinders, pistons, and bearings."

You can expect *your* Diesels to make such an operating record as this *after* you adopt Gulf Parvis Oil. This quality oil retains its high lubricating value for longer periods of time, giving you an extra margin of operating safety. And remember this: *More than 50 leading builders* of Diesel engines have approved Gulf Parvis Oil for the engines they build! You take no chances when you use this finer lubricant.

The Gulf line of quality oils and greases is quickly available to you through 1100 strategically located warehouses in 30 states from Maine to New Mexico. Write or phone your nearest Gulf office today.

This booklet will suggest to you a practical method by which you can reduce operating and maintenance costs for your Diesels. Write for your free copy.

Gulf Oil Corporation · Gulf Refining Company
3813 Gulf Building, Pittsburgh, Pa. .P.

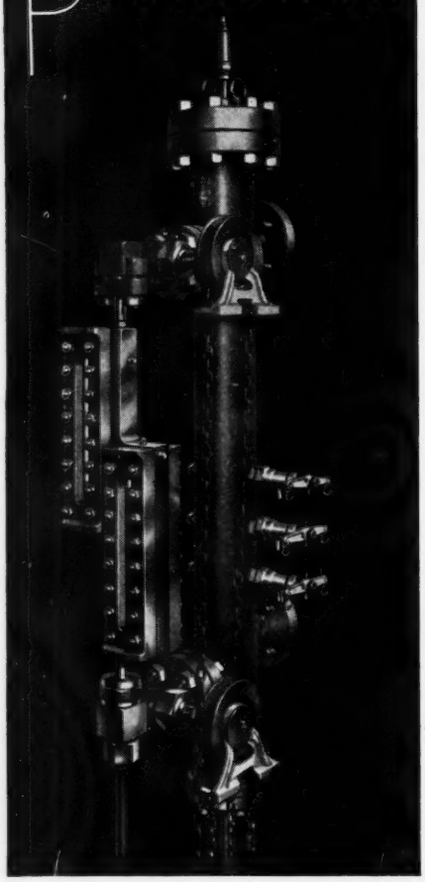
Please send me my copy — no charge — of the booklet "GULF PERIODIC CONSULTATION SERVICE."

Name .....

Company .....

Address .....

POSITIVE
Protection



Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

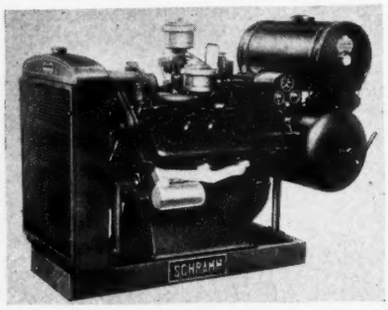
*Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1807. Write for a copy and working model.*

**YARNALL-WARING COMPANY**
100 Mermaid Ave. Philadelphia

YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

battery, starter controls, starter motor and battery generator. Units can operate on gas rather than gasoline if necessary.

*Schramm, Inc, West Chester, Pa.*



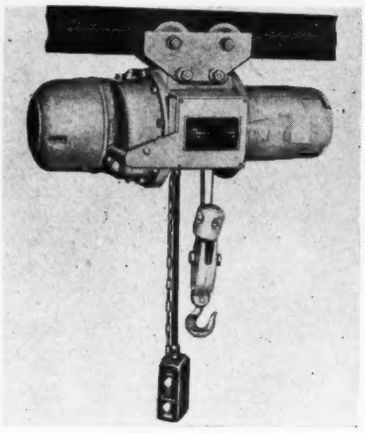

## Stop Leak Material

FLEXITE is used with ordinary Portland cement, and in operation is forced against water pressure, held for few seconds, and leak is stopped. Typical applications include stopping leaks in concrete tanks.

*Flexrock Co, 23rd & Manning Sts, Philadelphia, Pa.*

## Electric Hoist

LOAD KING is air-cooled, wire-rope electric hoist, made in two capacities: ½ and ¼ tons. Available in three types: lug, hook or plain trolley, with a choice of either



right-angle or parallel suspension. Other features claimed by maker are maximum ruggedness, standardized interchangeability of repair parts, small over-all dimensions, and high over-all efficiency.

*Philadelphia Div, Yale & Towne Mfg Co, Philadelphia, Pa.*

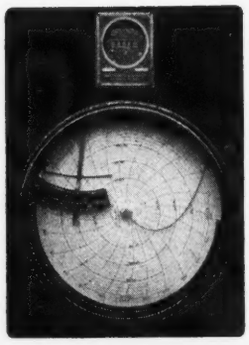
## Lubrication System

DUALINE JR, SYSTEM has two moving parts. Contains no springs or check valves and is fully adjustable, according to manufacturer. Positive delivery of lubricant to each bearing is made independently of the oiler's judgment or his ability to reach all bearings regularly. Maker claims new system will reduce labor of oiling, eliminate waste of lubricant, reduce repairs and maintenance, and prolong life.

*Farval Corp, Cleveland, Ohio*

A SYNONYM
for—Economy
—Accuracy
—Efficiency

SIMPLEX



The selection of SIMPLEX meters for your flow measuring problems insures ECONOMIES resulting from low first cost and minimum maintenance and operating charges.

The ability of the SIMPLEX meter to measure with extreme ACCURACY over wide flow ranges insures the obtaining of a definite knowledge of all flow conditions.

Only by the complete instrumentation of all flow functions can true operating EFFICIENCIES be obtained.

There is a SIMPLEX instrument FOR YOUR specific problems.

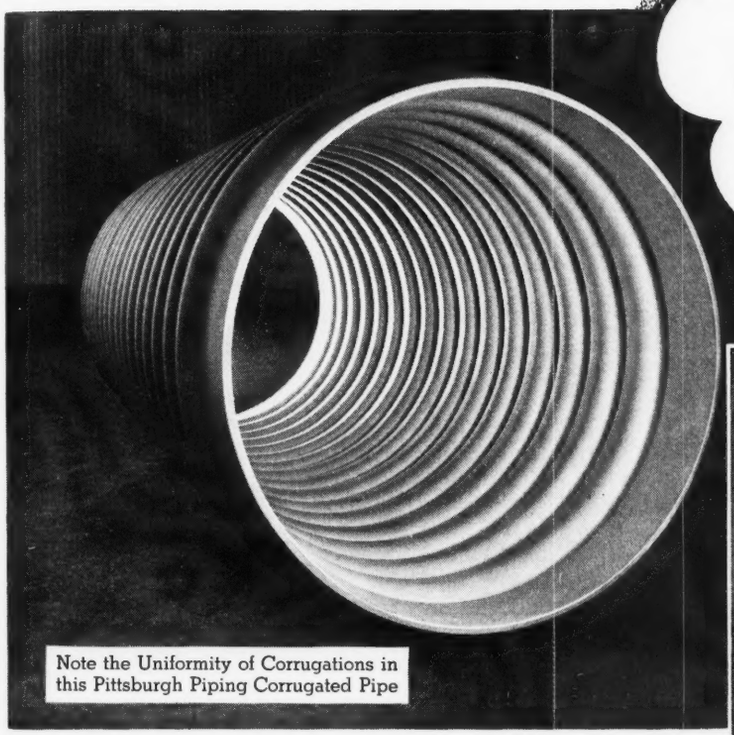
Let our engineers show you how the proper selection of your metering equipment can insure greater plant ECONOMIES and EFFICIENCIES.

***Write for Data***

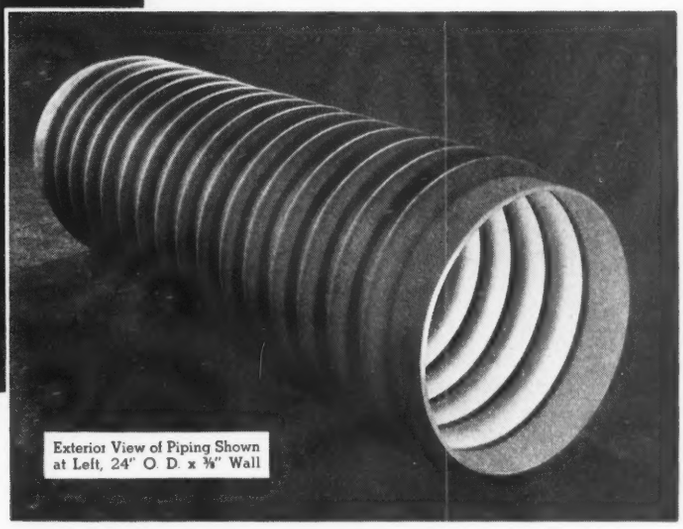
**SIMPLEX**
**VALVE & METER CO.**
**6780 Upland Street**
**PHILADELPHIA, PA.**

# uniformity *of corrugations*
## IN PITTSBURGH PIPING CORRUGATED SECTIONS

***is the answer to***
***MAXIMUM FLEXIBILITY***
***of steam piping***
***in limited spaces***



Note the Uniformity of Corrugations in this Pittsburgh Piping Corrugated Pipe



Exterior View of Piping Shown at Left, 24" O. D. x ⅜" Wall

IF you will take a few seconds to study the above two illustrations of corrugated pipe, you will note that each corrugation is uniform in height and spacing. The design of the corrugations is carefully worked out on a sound basis for pipe of each size and wall thickness to give the best operating results. It is then faithfully reproduced in the pipe to extremely close tolerances.

This uniformity is necessary in order to obtain proper distribution of stresses throughout the entire piece of pipe when in service. Actual test results show that Pittsburgh Piping Corrugated Tangents are at least 5 times as flexible as straight pipe of the same dimensions.

Whenever you are limited for space and find that conventional piping will produce excessive stresses and end reactions, remember that Pittsburgh Piping Corrugated Tangents will be the answer to maximum flexibility in this minimum space.


**PITTSBURGH PIPING & EQUIPMENT CO.**
**10 FORTY-THIRD STREET PITTSBURGH, PA.**

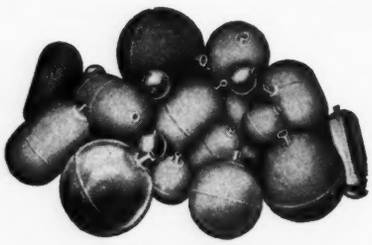
Woolworth Bldg., New York Occidental Bldg., Indianapolis Peoples Gas Bldg., Chicago Union Guardian Bldg., Detroit
Public Sq. Bldg., Cleveland 10 High St., Boston Liberty Life Bldg., Charlotte 525 Market St., San Francisco

For complete technical information about Pittsburgh Piping Corrugated Pipe write for your copy of the Pittsburgh Piping Design Manual.

*Pittsburgh Piping*

# NICHOLSON

## HIGH PRESSURE WELDED FLOATS—Stainless Steel-Chromium Plated Steel



Available for all applications—for steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.—for corrosive and non-corrosive service.

Made in spherical and elliptical shapes in sizes from 2½" to 14" diameter. High in tensile strength and offer great resistance to external pressure. Special sizes and shapes available to order, and also cadmium, nickel or copper plated. Fully described in Bulletin No. 339.

## 2-, 3- or 4-WAY CONTROL VALVES for SINGLE and DOUBLE ACTING CYLINDERS

Special types also available.

Designed for long life, quick and dependable control of air, steam, oil, gas or water on pressures up to 300 lbs.

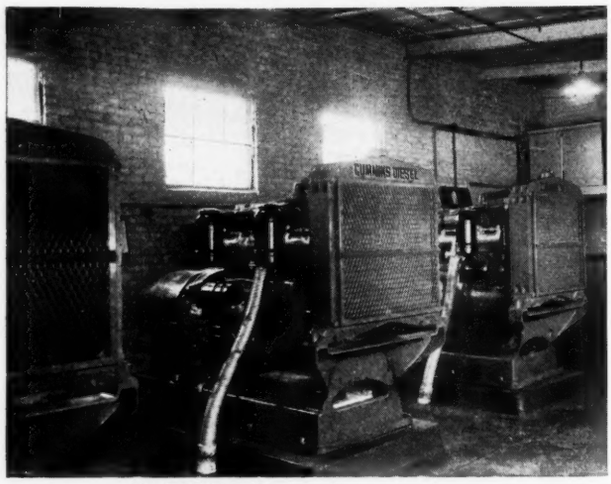
Made also in foot, solenoid and motor operated types—also balanced valves for high pressure hydraulic service. Ask for Bulletin No. 933 for details.

**OTHER PRODUCTS**

NICHOLSON Industrial Steam Traps, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

**W. H. NICHOLSON & COMPANY**
125 OREGON ST. WILKES-BARRE, PENNSYLVANIA, U. S. A.

*"Tight as pipe but flexible"*



## *Increased* Efficiency with PENFLEX Exhausts

Sizes 1" to 16"

The above trio of Cummins-powered generating sets are a joy to their owners. They are delivering as promised —*plus*. Part of this "plus" is due to those easy-bend exhaust pipes; also, to the fact that this flexible all-metal tubing is free to expand and contract at will . . . with ⅜" of "come and go" for every foot of length. Bends are made without use of heat or special tools. Maintenance efficiency, too, is greater on account of easy handling during overhauls. Let us sketch a layout for your diesel power plants.

***Send for Bul. 70***

**Pennsylvania Flexible Metallic Tubing Co.**
**7202 Powers Lane, Philadelphia, Pa.**


# Readers' Problems

*(Continued from page 109)*

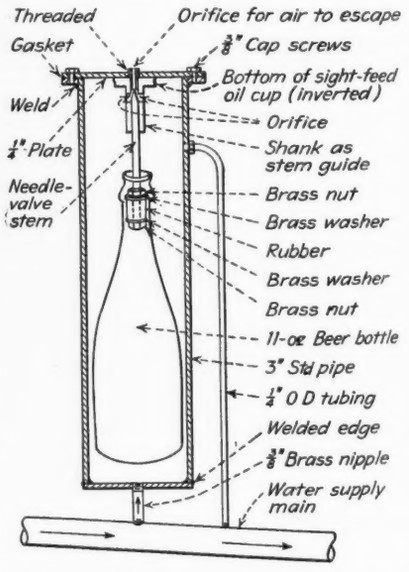
either put an alarm on the reservoir to warn when it is almost drained, or clean out sediment in the pipe and eliminate any restrictions between reservoir and crest such as small strainers, checks, valves, and fittings, which may be causing enough friction to offset the normal 12-ft head. If atmospheric air is not allowed to get into the pipe by draining either reservoir or discharge leg, or through a leak near the crest, I cannot see any other cause for the trouble except a restriction in the pipe. If the line is unrestricted, and there is enough of a drop from crest to discharge valve to overcome pipe friction, the pressure exerted by the 12-ft head should be more than enough to prevent the formation of a partial vacuum at the crest and therefore no air could separate from the water at any low rate of flow.

*Tacoma, Washington* R E CHASE

## Home-Made Air Valve

THE TROUBLE RESULTING from air pockets in pipeline crests can be overcome either by venting with a small riser pipe or by air relief valves, of which there are several on the market. The sketch shows a valve that we made of materials available around most plants. This device cured the trouble we had with an airbound line.

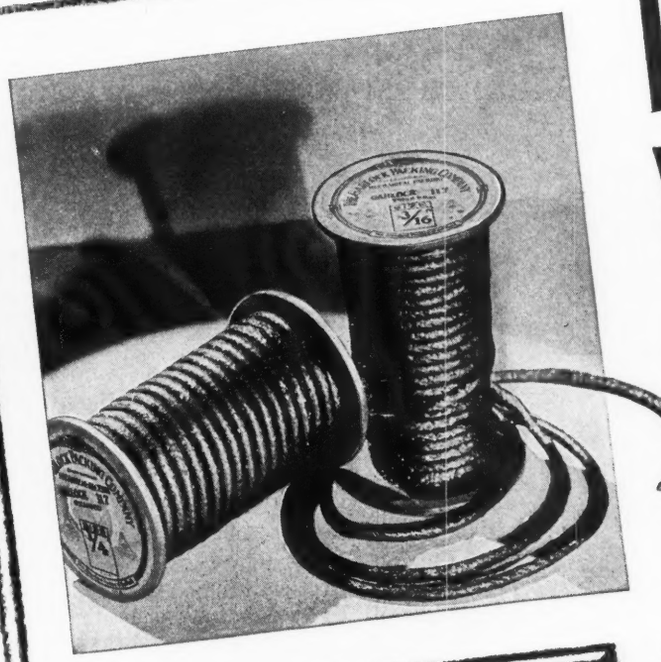
This valve has been in service for 8 years at a point where a 30-ft head exists. It is placed close to the main with a section of a large range boiler around it. The boiler-section is provided with a lid for inspection. Burying it in the ground makes it frostproof, which would be difficult to achieve on a riser vent of any height.




*Prescott, Ore.* J A OBERSTALLER

## Install a Vent Trap

PSW DOES NOT STATE whether or not there are other peaks than the one mentioned. I believe that there must be more than one

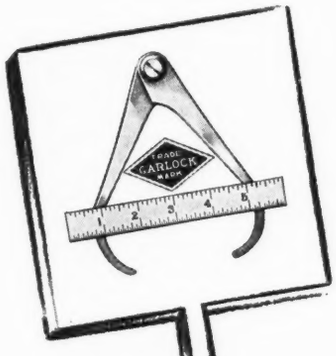


# INDUSTRY VOTES FOR GARLOCK 117

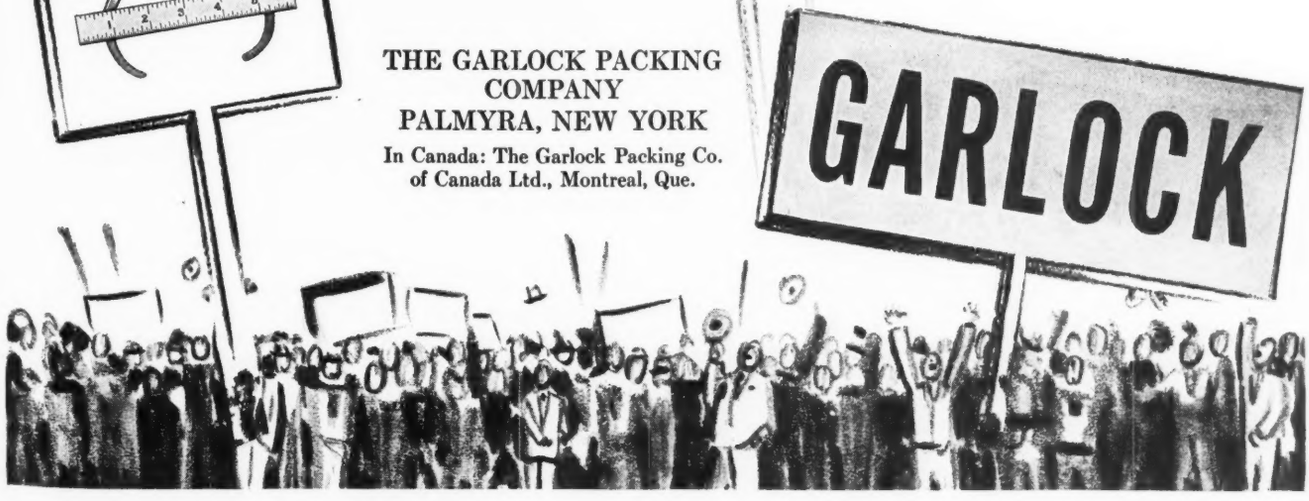
*For Satisfying, Dependable Service!*

IF THERE were elections to pick the valve stem packing that should be used—voting would be little more than a formality, because most engineers and maintenance men have learned from experience that GARLOCK 117 does the job right.

GARLOCK 117 is used on stems of globe and angle valves operating against high-pressure steam, hot or cold water, or oil. It is made from long fibre asbestos yarn, thoroughly lubricated with a special Garlock heat-resisting compound. Furnished either braided or twisted in sizes from $\frac{1}{16}$" up. Specify GARLOCK 117!




THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.



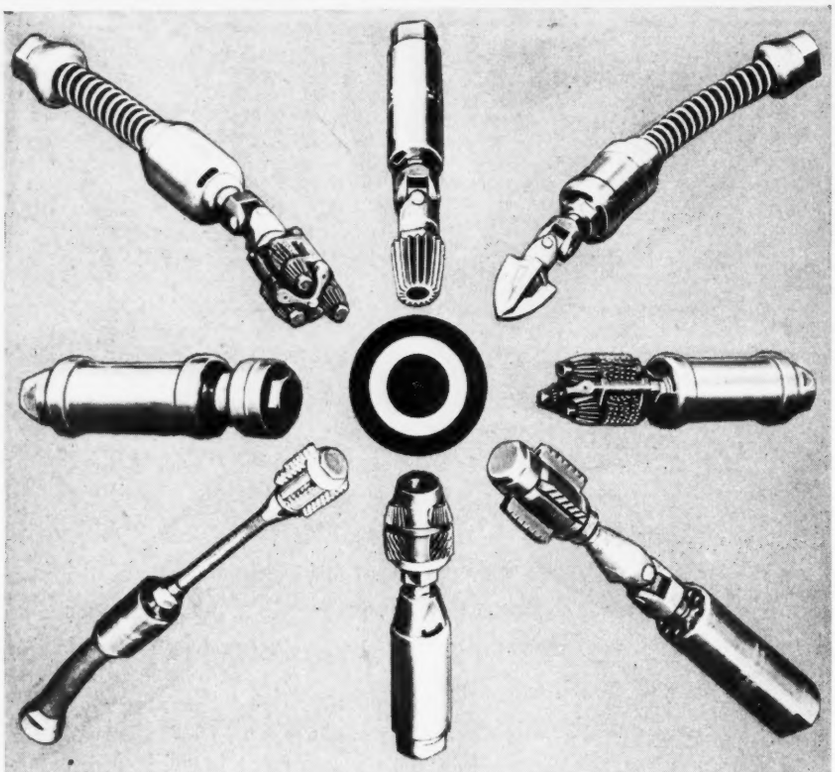
ADVERTISING PAGES REMOVED

SAVE AIR—SAVE DOLLARS
WITH
ROCKWELL BLAST GATES
For Low Pressure Air
Slide Type Butterfly Type
Wafer Butterfly Type
Kwikleen Type

Threaded Butterfly Type

Write for catalog No. 3760
W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK

Wafer Butterfly Flanged Type



A WILSON TUBE CLEANER CLEANS *ANY* TUBE *BETTER*

Wilson tube cleaners do *better, faster, more economical* tube cleaning because they are designed and built for the specific job they have to do. There's a Wilson tube cleaner specially designed for efficiently and economically cleaning *any* tube or pipe—straight or curved—of large or small diameter—that *can* be cleaned mechanically.

In both laboratory tests and under the severest operating conditions Wilson tube cleaners have proven their superior power, efficiency and economy over and over again.

Let us help you solve your tube cleaning problems. Send for the name of our representative nearest to you or for a copy of our new thirty-six page catalog.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

peak or else the one peak is higher than the question supposes so that it is near the water line in the reservoir. It would be impossible to get air binding with one peak only, as long as that peak is lower than the reservoir. Assuming there are several peaks, the line can become air-bound when open full at the boiler room.

The simplest remedy would be to install an air vent at the highest peak; vents on lower peaks would probably be unnecessary. A suitable air vent would be one made like a float-operated steam trap except that the valve is arranged to close when the float rises.

*Birmingham, Ala.* J W NORTH

## Float Valve at Reservoir

FROM THE WORDING of this question one would suspect that the water level is being lowered enough, during boiler washout periods, to form a vortex and draw air into the line. If this is the case, a simple float valve could be rigged to shut off the tank outlet when the water level approaches the vortex point. PSW would then have to wait until the flow of water from the spring had filled the reservoir to a point where operation could be resumed.

If flow from the spring is greater than any peak flow from the small reservoir, a vortex may still be formed on high flows. The remedy in this case would appear to be a larger reservoir.

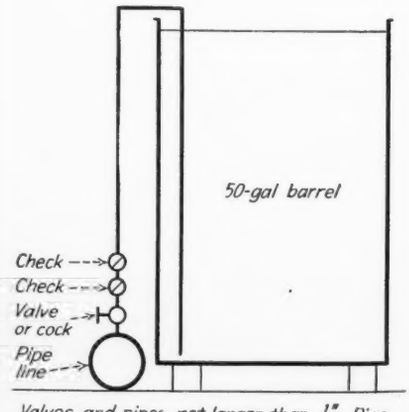
*Hamilton, Ontario* E T W BAILEY

## Install a Snifter

AS PSW HAS PROBABLY DISCOVERED, his trouble comes from a large air bubble at the crest in the line; the air is sucked into the entrance at the pipe or absorbed by the water in the reservoir. If it is sucked in, this can be cured by lowering the intake and installing a baffle so that water will have to travel horizontally under it before entering the pipe.

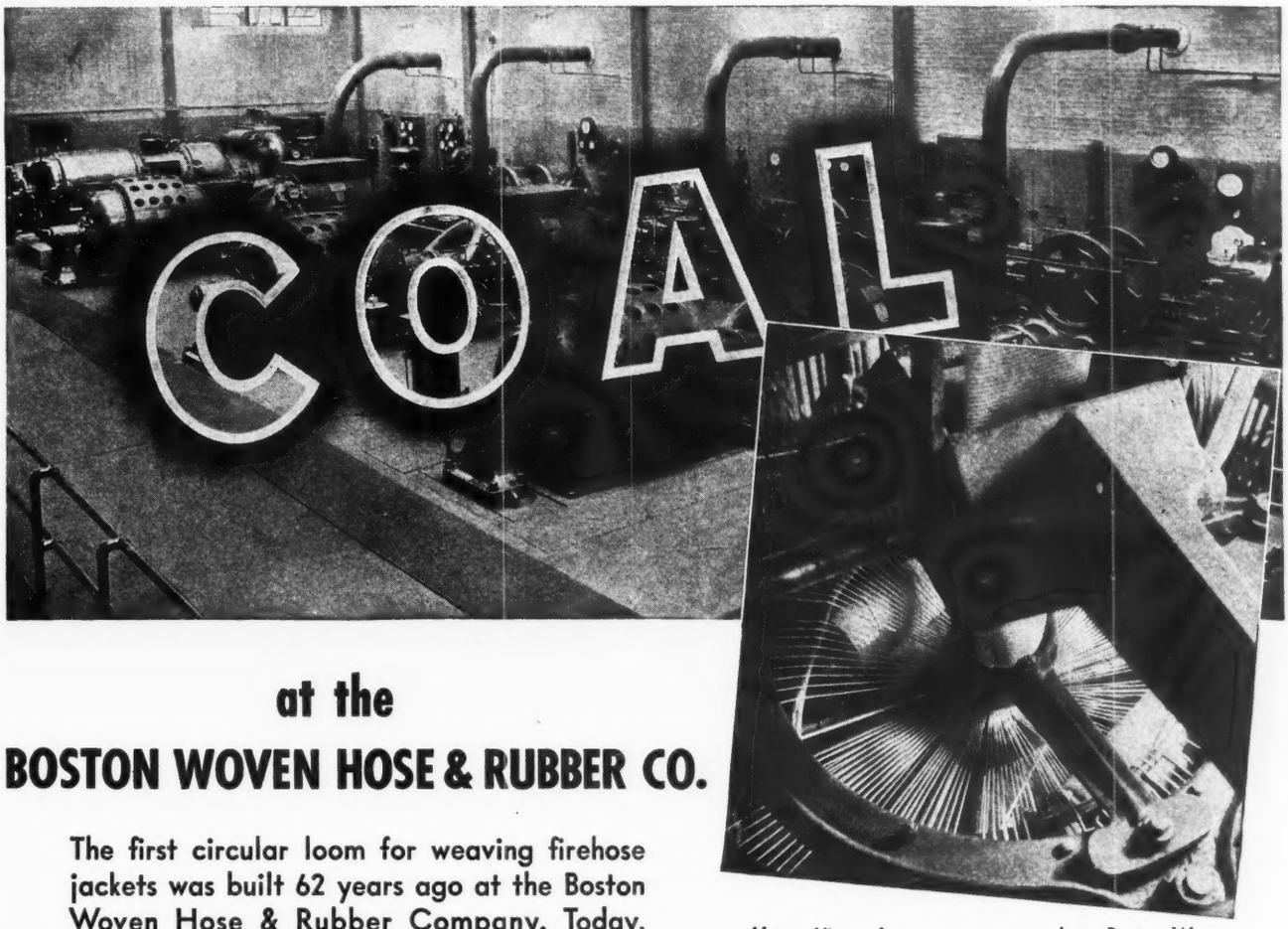
The surest way to cure the trouble is to grade the pipe from the reservoir to the crest so as to avoid the dip in the line. If this involves too much work or expense, a vent or snifter may be installed at the highest point of the crest. Either will discharge any air that collects until pressure drops to zero, but if the pressure goes be-

*(Continued on page 166)*




*Valves and pipes not larger than $\frac{1}{4}$" Pipe should preferably be brass or copper tubing.*

# *DEPENDABLE* POWER FROM *DEPENDABLE* FUEL




## at the
## BOSTON WOVEN HOSE & RUBBER CO.

The first circular loom for weaving firehose jackets was built 62 years ago at the Boston Woven Hose & Rubber Company. Today, modern counterparts of that first loom turn out several hundred thousand feet of firehose every year.

Another case where *constant, dependable* POWER helps complicated machinery meet production schedules. And the source of power here—as in so many other industries—is COAL, the *economical, reliable fuel.*

Compare Coal with competing fuels! Chesapeake and Ohio offers you the free service of trained Fuel Service Engineers to help you make comparative cost studies of COAL.

*Above*—View of generator room, where Boston Woven Hose & Rubber Company generates 13,000,000 kilowatts of electricity. *Inset*—battery of modern circular looms.

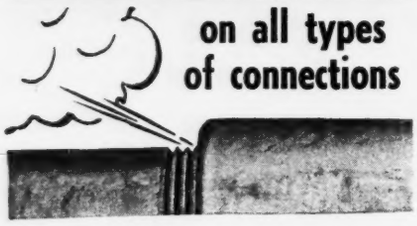
• • •

These combustion experts can also help you secure the type of Coal best suited to your needs, for this railroad serves "The Coal Bin of America"—the largest bituminous coal field in the country. From modern mines in this area you can get coal prepared and sized to your exact specifications. You can depend, too, on this railroad for careful, quick delivery of your Coal, *when* you need it, and where you want it.

**For information or assistance with your fuel problems, write GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2901 Terminal Tower, Cleveland, O.**

**CHESAPEAKE AND OHIO LINES**

# To prevent or stop pipe joint leaks



## on all types of connections

When leaks occur at screw-thread pipe joints, reassembly with Smooth-On No. 3 will assure a lasting seal *even if the threads are worn or damaged.*

On gasketed and other pipe connections, too, Smooth-On makes and keeps the joints tight, because this soft metal filler retains its body, does not dry, shrink or blow out, is not affected by steam, water, oil or gas, and holds perfectly even at high pressures or wide temperature variations.

By making up all new pipe joints with Smooth-On No. 3 and keeping a can handy for use on troublesome old pipe joints you can be sure of perfect and permanent joint tightness.

Buy Smooth-On in 1-lb., 5-lb. cans or 25-lb., 100-lb. kegs from your supply house or if necessary, from us. For your protection, insist on Smooth-On—used by engineers since 1895.

**FREE**

**40-Page REPAIR HANDBOOK**

—full of valuable suggestions that will save you time, effort and money on equipment repairs, such as sealing cracks in heaters, pumps, tanks, etc., stopping leaks at seams and bolts, tightening loose fixtures and parts of apparatus, waterproofing walls, floors, etc. Send the coupon for your copy.

SMOOTH-ON MFG. CO., Dept. 30
570 Communipaw Ave., Jersey City, N. J.

Please send copy of the SMOOTH-ON-HANDBOOK.

Name .....

Address .....

10-3-40 .....

*Do it with*
**SMOOTH-ON**


low zero, the vent will admit air which would again restrict the flow. However, a snifter constructed according to the sketch will admit no air at all or, if the checks leak, not until the barrel is empty, which might be long enough to tide PSW over a period of heavy flow.

The second check is used in the hope it will stay tight if the first leaks, and the barrel gives further protection against air leakage into the line. If, in spite of the snifter, the line becomes airbound again due to liberation of dissolved or absorbed air, PSW can restrict or stop the flow by closing his valve, and the snifter will quickly discharge the air.

*San Diego, Calif.* C A LeQuesne

## Power Lines

*(Continued from page 130)*

crankcase - compression, backflow-scavenging type, with water-cooled exhaust manifolds. Each drives a 1750-rpm, 0.8-pf, 300-kw F-M alternator with V-belted exciter. Essential engine auxiliaries comprise Woodward isochronous governors, Alnor pyrometers and thermometers, Gardner-Denver starting-air compressors and Diesel Specialties Co air tanks.

Intake air enters through American impingement filters mounted on the wall outside the building, and passes to the engines through ducts entering the building underground. The Fairbanks-Morse silencer does double duty; fans draw air from the engine room, near the floor, force it between the silencer and metal jacketing, and discharge it, heated, through grilles in the upper engine-room wall (see photo). In summer, the fans serve to draw off warm engine-room air, discharging outside.

The closed cooling system employs duplicate Ross heat exchangers, and F-M cooling-water pumps, cross-connected for emergency operation. For safe and reliable operation, an Edwards thermo-control valve and water-pressure alarm are provided, with an Alnor water-temperature indicating pyrometer for each unit. A 75,000-gallon spray pond, fitted with Binks nozzles, takes care of cooling. For make-up, Graver Tank Co zeolite units soften raw water from a deepwell on the site.

Lube oil from the engine crankcases drains by gravity into a dirty-oil reservoir; a Hilliard Corp reclaimer restores the oil before its return to a clean-oil tank. Electrical heating is provided. A Goulds centrifuge conditions fuel oil; a Viking pump handles the transfer.

Modern equipment for electrical distribution and control is housed in a specially constructed compartment below the balcony at one end of the engine room (see photo). The dead-front Allis-Chalmers board and switchgear carries a full complement of Westinghouse instruments.

### Fred Jolley Honored

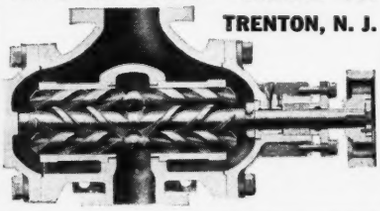
NAPE delegations from New York, New Jersey and Connecticut joined hands to honor Frederick G Jolley, retiring after 30 years as salesman for Jenkins Brothers,

**GOOD COMBUSTION** *needs* **STEADY PRESSURE**

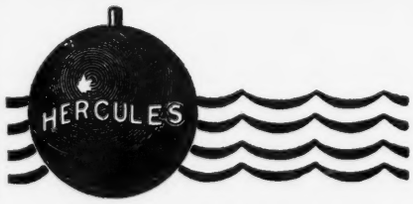
IMO means I MOVE OIL

These three De Laval-IMO's are delivering Bunker C to the burners at a continuous, steady 300 pounds pressure in a large central station. The De Laval-IMO rotors displace oil continuously and uniformly without pulsation. Catalog I-61 tells why.

**DE LAVAL STEAM TURBINE CO.**
TRENTON, N. J.



**HERCULES**
*Seamless Copper*
**FLOATS**




**GUARANTEED TO STAND UP!**

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

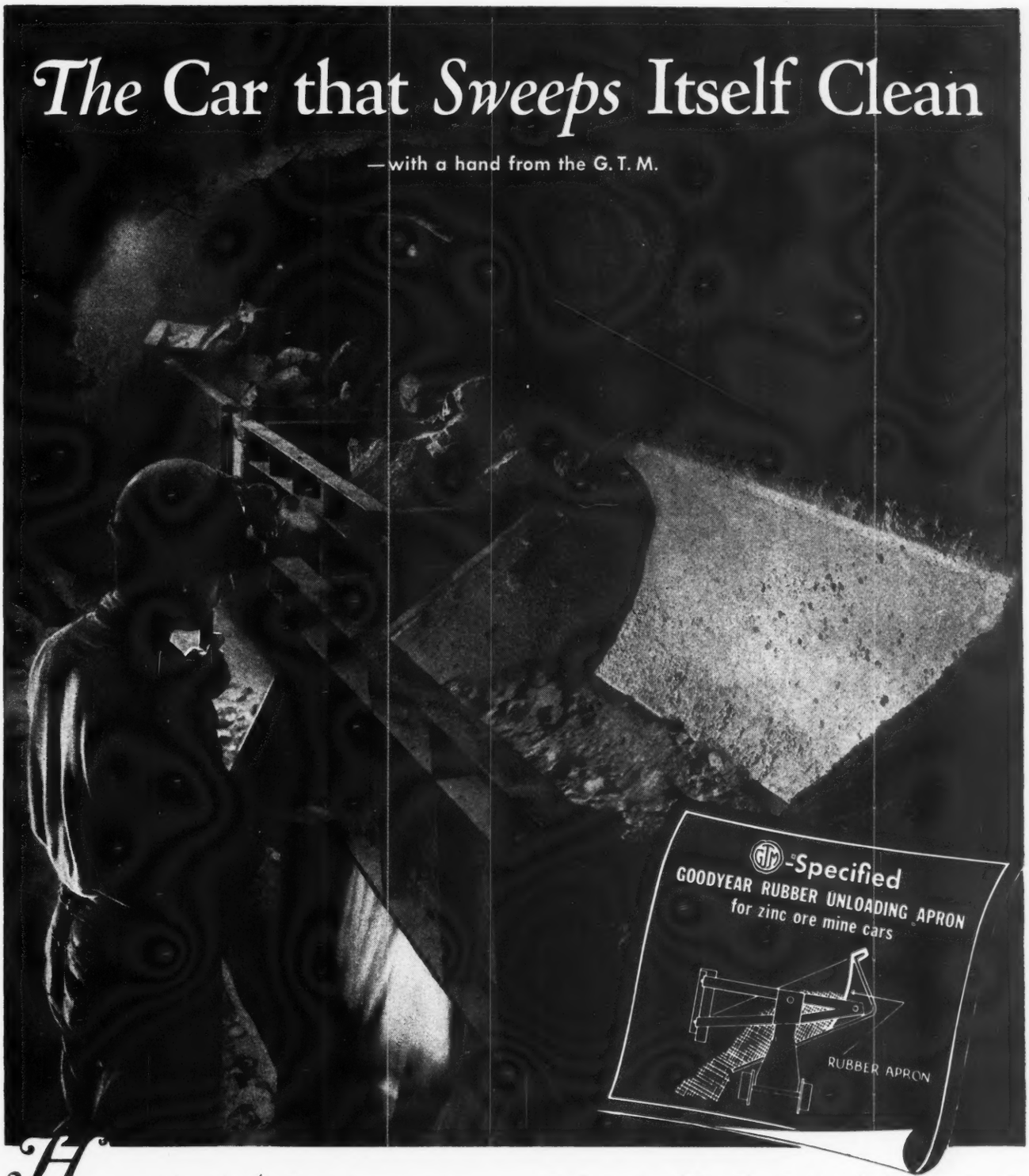
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

**HERCULES FLOAT WORKS**
200 Franklin St.
SPRINGFIELD, MASS.

# *The* Car that *Sweeps* Itself Clean

—with a hand from the G. T. M.

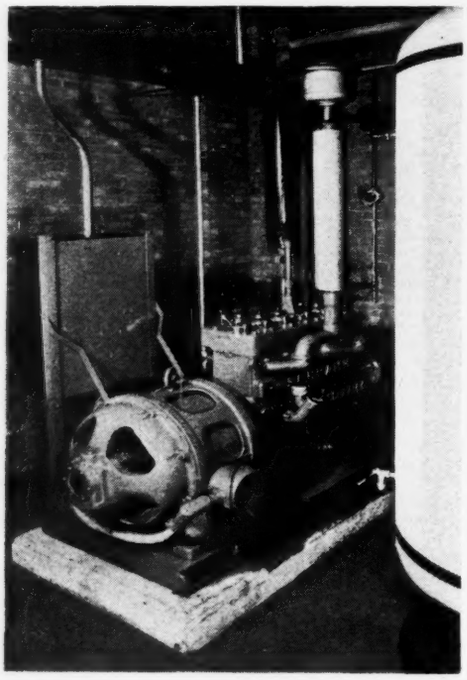



*Here you see how a bottleneck in a large zinc mine was broken, through an ingenious application of rubber by the G. T. M. — Goodyear Technical Man. Dump cars that wouldn't dump were the trouble. Wet, soggy ore was the reason. Ore stuck so tenaciously inside the cars, particularly in the lower back corner, that a third or more of every load had to be laboriously scraped out by hand — a slow costly operation. Since wet ore does not adhere to rubber, the G. T. M.'s answer to this sticker was to line the back of the cars with an apron of tough, smooth Goodyear Armadillo rubber-sheeting, firmly clamped at the top, free to swing at the bottom. Now, when a car dumps, the rubber apron swings forward,* sweeping the ore before it and emptying the load in a jiffy. *This installation is typical of scores of new uses of rubber developed by the G. T. M. to expedite the handling of all types of materials from zinc to acids. To consult him on your problem, write Goodyear, Akron, Ohio, or Los Angeles, California — or phone the nearest Goodyear Mechanical Rubber Goods Distributor.*

THE GREATEST NAME IN RUBBER

GOODYEAR

# SCHRAMM
## AIR COMPRESSORS



OCCUPY SMALL FLOOR SPACE. The base for this 600 C.F.M. Direct Motor Drive Compressor is 74½"x37½"

LUBRICATION is by pressure to all bearings

COOLING is by running water through aftercooler and then through the compressor

OPERATION is continuous —24 hrs. per day

MOTOR is 100 H.P.

NO ERECTION COST Completely assembled motor driven compressor is delivered on base.

ADJUSTMENTS are easily made. All parts are accessible.

SCHRAMM, INC., WEST CHESTER, PA.



# Which Road Would YOU Take?

**All of us like to feel that we are getting our money's worth. However, VALUE claims a reasonable price! ★ For sixty-six years Quality has been our first consideration. A few of our outstanding products are**

**TURBINE OILS • COMPRESSOR OILS**
**CYLINDER OILS • DYNAMO OILS**
**DIESEL ENGINE OILS • MOTOR OILS**
**GREASES**
**for all purposes**

BORNE SCRYMSER COMPANY
ESTABLISHED 1874
17 BATTERY PLACE NEW YORK


in a testimonial dinner at the Deshler-Wallick Hotel, Columbus, Ohio, on August twenty. 60 were present, including ladies as well as many engineers prominent in the activities of the Association.

Tributes by toastmaster Horace Wilds, past national president, and many others, stressed Mr Jolley's human qualities, not-

**Fred Jolley**

ably his friendliness and his squareness to all, as revealed in many years of contact with the NAPE.

After learning the machinist's trade, in the shops of B W Payne Engine Company at Elmyra, N. Y., Fred Jolley served five years as operating engineer for the Astor Estate, New York. His subsequent sales career in the engineering field totaled 42 years—one year with Dearborn Chemical Co, eleven with T R McMann, 60 Gold Street, New York, and the last 30 with Jenkins Brothers. He was president of Phoenix Association No. 2 (New York) NAPE for two years.

## TVA Adds Steam, Hydro Capacity

Three large General Electric waterwheel generators, costing more than $1,200,000, have been ordered by the Authority for the Cherokee Dam powerhouse, on the Holston River, near Jefferson City, Tenn. Construction on this dam will be rushed. Each generator is rated 33,333 kva, 13,800 volts, and 94.7 rpm.

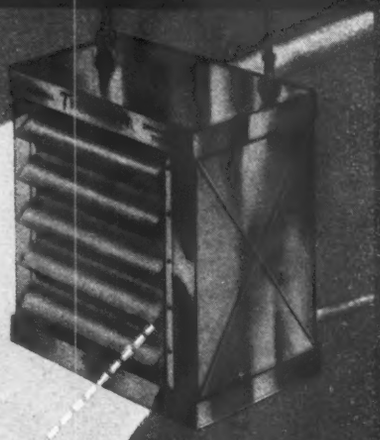
Two 60,000-kw turbine-generators, also from General Electric, have been ordered for a new steam-electric power plant to be erected at Watts Bar, near Chattanooga, Tenn. This plant is expected to go into service in 1942. Each unit will be supplied with steam at 850 lb, 900 F, with exhaust pressure at 2 in. Hg. Generators will be air-cooled, operating at 1800 rpm.

## Transformers Ordered For Grand Coulee

Six additional giant transformers for the initial power installation in the world's largest power plant at the Grand Coulee Dam, Columbia Basin project, Washington, were ordered recently from the General Electric Co. These are 36,000 kva, 60-cycle units, three of which were ordered in the early part of this year for another installation at the same dam. These main

# *Exclusive*

## "FULL HEAT" ZONE



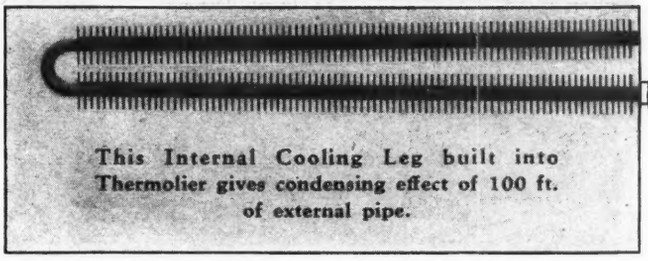
## ...typifies Thermolier's advanced design!

There's one quick way to tell which unit heater is engineered to give maximum *overall* economy. Find out which one produces continuous "full heat" from all radiating surfaces, in *actual performance*, as well as standard rating tests!

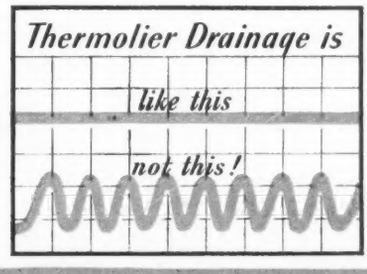
Only Thermolier has the exclusive Internal Cooling Leg that insures *continuous* drainage of condensate . . . *continuous* live-steam radiation from all surfaces. It eliminates intermittent drainage cycles that cause temperature variations and losses in heating efficiency in as much as 1/3 of the heating surface.

This is but one example of original Thermolier features that provide cost-cutting simplicity of installation, fuel-savings up to 27%, and lower maintenance costs. Others include expansion-compensating U-tubes and the same tube-to-header construction used in condensers.

Write for complete Data Book on Thermolier . . . the unit heater so efficiently designed that it has required no changes since its original development! Available in 37 types and sizes. Grinnell Co., Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities of the United States and Canada.



This Internal Cooling Leg built into Thermolier gives condensing effect of 100 ft. of external pipe.



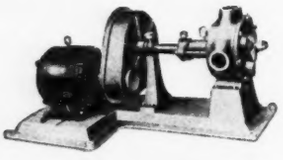

# GRINNELL THERMOLIER

THE UNIT HEATER WITH 14 POINTS OF SUPERIORITY

WAR ON WASTE

with VIKING ROTARY PUMPS

- Compact in design, Viking requires only a minimum of room for quick installation. NO WASTE SPACE!
- Built specifically for the job it is intended to do, Viking performs with greater efficiency, greater accuracy. NO WASTE MOTION!
- Employing only 2 moving parts, Viking operates longer at less cost. NO WASTE POWER!
- Bulletin 2500-40 gives you just the real facts and specifications on Viking Auxiliary Pumps for industrial power service. NO WASTE READING!



LOOK FOR THIS TRADE MARK—THE SIGN OF A GENUINE VIKING

VIKING PUMP CO.
CEDAR FALLS, IOWA

step-up transformers to be furnished will be installed adjacent to the upstream wall of the powerhouse on a deck between the powerhouse and dam. The high-voltage switching station will be approximately ½ mile west of the left powerhouse. Overhead high-voltage circuits will connect each bank of step-up transformers with the switching station.

## Power Show Dec. 2-7 Draws High Interest

With plant expansion under way or definitely projected in more than half the nations metal-working establishments alone, manufacturers of power-plant equipment and mill supplies are showing a lively interest in the new business prospect, according to Charles F Roth, president of the International Exposition Co and manager of the 14th National Exposition of Power and Mechanical Engineering. The Power Show will be held in Grand Central Palace, New York, December 2 to 7, coincident with the annual meeting of The American Society of Mechanical Engineers.

Although the Power Show is a few months away, reservations for exhibition space are rapidly being taken up. To date more than 270 concerns have contracted for space to display their products.

Among the first to disclose the nature of their displays at the forthcoming Exposition is a large proportion of concerns specializing in power-house and plant equipment and supplies. Many of these concerns have extended their lines and introduced new materials and appliances since the last Power Show, two years ago, and now reveal that additional innovations are in store for the forthcoming Exposition.

Since mechanical power is equally essential with manpower in converting raw materials into finished products, the universal increase in manufacturing induced by the national preparedness program necessarily involves a heavy increase in demand for power from all sources, from the smallest motor-driven tools to the largest steam and hydraulic turbines. Many new installations of prime movers and auxiliaries, and a tremendous investment in the rearrangement and re-equipment of existing plants, are forecast within the next two years, affecting all industries.

## 1,000,000-lb-per-hr Boiler Tops Sherman Creek

The latest extension in the construction program of the Consolidated Edison Company of New York, Inc, is the topping of the Sherman Creek Station, 201st St and the Harlem River. This 200-lb station, placed in operation in 1913 and increased in capacity from time to time, contains six turbine-generators aggregating approximately 140,000 kw.

This topping installation will consist of a 1,000,000-lb-per-hr steam-generating unit.

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

MAKE YOUR OVERHEAD VALVES SAFE and EASY TO REACH—
CONTROL VALVES FROM THE FLOOR

With Babbitt Sprocket Rims on your overhead valves, you can control valves instantly from the floor. Far quicker and safer than climbing ladders.

Babbitt Rims are easily attached in a few minutes, are inexpensive and assure safe, positive and instantaneous overhead valve operation. Available for valves of every make or style. Write for details.

BABBITT STEAM SPECIALTY CO.
New Bedford Mass.

TIME COUNTS HERE

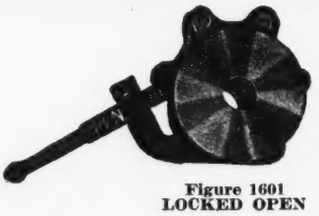


Figure 1601
LOCKED OPEN

SPEED is the order of the day. The airplane and the automobile play important parts in the lives of people. Moving pictures are commencing to take the place of books in education, and shortly students will be learning from films more than from the printed page.

EVERLASTING SPECIAL WATER COLUMN CONNECTION VALVE

For Connections between Boiler and Water Column.

A SAFE AND SURE VALVE APPROVED BY A.S.M.E. CODE AND BOILER INSPECTORS.

IN EMERGENCY, CAN BE INSTANTLY CLOSED WITH ANY SUITABLE FIRING TOOL. NO TIME LOST WHERE SECONDS CAN MEAN SO MUCH.

*Write for Bulletin E-58A.*

EVERLASTING VALVE COMPANY
Jersey City New Jersey

*In Canada: Everlasting Valve Co., Ltd., Toronto*
*In England: Everlasting Valve Co. (Gt. Britain), Ltd., London, S.W. 12.*

# Get this new OHMITE Catalog and Manual

## A Wealth of Valuable Data about Resistors, Rheostats, Tap Switches and their Applications

*IT'S MORE THAN A CATALOG*—it's a complete, handy reference on the use of resistors, rheostats, and tap switches in the control of motor speed, of heat and light, of signal and supervisory circuits—in products and machine tools — in laboratories, maintenance and production — and in electronic devices.

### 96 PAGES TELL EVERYTHING!

- ★ Valuable Engineering Data!
- ★ Complete Dimensional Drawings!
- ★ Manual of Resistance Measurements!
- ★ Handy Reference Tables!
- ★ Practical Application Information!
- ★ Wide Range of Stock Units and Special Units in Resistors, Rheostats, Tap Switches, Chokes and Attenuators, for Industrial, Precision and R. F. Applications.
- ★ Describes New Products!
- ★ Covers the Most Complete Line!
- ★ Tells How to Select the Right Units!
- ★ Helps You Plan Special Units!
- ★ Saves You Time, Effort and Money!

### THERE'S NOTHING LIKE IT!

It's truly an encyclopedia of helpful information — an invaluable guide packed full of tangible, usable data for engineers, production managers, and purchasing departments!

Clip this coupon to your company letterhead or write us on company stationery giving your name and position. Catalog 40 will be sent to you at once without obligation.

**OHMITE MANUFACTURING CO.**
**4823 Flournoy Street, Chicago, U. S. A.**

Please Send Catalog 40. No obligation.

Company Name .....

Individual Name .....

Position or Title .....

Address .....

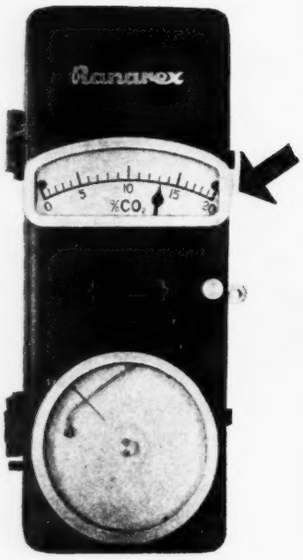
City ..... State .....

P-10

Be Right with OHMITE
RHEOSTATS · RESISTORS · TAP SWITCHES

# LOOK..

*That's all you have to do to measure combustion efficiency*




- Only mechanical $CO_2$ meter
- Simple, rugged, trustworthy
- Readings almost instantaneously
- Permanent 24-hour record
- Operates on lighting circuit
- No orifices, chemicals or fragile parts
- Accurate within 3/10 of 1%
- Saves up to 20% on fuel
- Product of Permutit

*Free Booklet:*
*Write The Permutit Company*
*Dept. A*
*330 W. 42nd St., New York*

**"RANAREX"***

*Mechanical $CO_2$*
Indicator & Recorder

*TRADEMARK REG. U.S. PAT.OFF.


designed for 1775 lb pressure and supplying steam at 1600 lb, 955 F to a 50,000-kw, 3600-rpm turbine-generator exhausting to the present 200-lb station header. The turbine-generator, a Westinghouse unit, is hydrogen-cooled.

The steam-generating unit, for which contract was let to Combustion Engineering Co on August 26, will be a 3-drum, bent-tube boiler with Elesco superheater and economizer, two Ljungstrom regenerative air preheaters and a steam washer in the steam drum. It will be tangentially fired with pulverized coal from three C-E Raymond bowl mills and have a continuous slag-drip furnace bottom. In addition to the twelve coal burners, three in each corner, there will be two oil burners in each corner, between the coal burners, and four horizontal oil burners in the front upper wall. The latter are for maintaining performance with oil comparable to that when burning coal.

Plain bifurcated tubes will be employed for the front, rear and side furnace walls and the roof and bottom will have fin tubes. The unit itself will occupy a space 49 x 53 ft between building columns and will extend approximately 90 ft to the top of the air heaters, the mills being at the basement level.

## New Equipment For Reeves Ave Addition

Stone & Webster Engrg Corp, Boston, has purchased a 40,000-kw Westinghouse turbine-generator, rated 3600 rpm, 11,500 volts, 3 phase, 60 cycles, with an 80% power factor; a Combustion Engineering boiler with 400,000 lb of steam per hour capacity at 875 lb, 900 F; and an Ingersoll-Rand, single-pass, 30,000-sq-ft condenser with auxiliaries; all for installation in the Reeves Avenue addition to the Norfolk, Va., plant of Virginia Electric & Power Co.

## Oil Refineries Buy More Gas Turbines

Two gas-driven turbines, first to be built for sale by the General Electric Co, have been ordered by oil refineries. Details of the machines cannot be revealed, since catalytic processes in which they will be involved are secret. The units will be rated at 3250 and 400 hp.

## Hydro Turbines for Pickwick, Wilson Dams

Allis-Chalmers Mfg Co, as low bidder, has been awarded contracts for one hydraulic turbine for the Pickwick Landing Dam project and two hydraulic turbines and two generators for the Wilson Dam project, which in the aggregate will amount to approximately $1,660,000. On all of these units the government has asked the promptest possible deliveries, in compliance with the President's emergency order speeding up war work.

The Pickwick Landing hydraulic tur-


# JUST AS YOU SEE IT HERE!!

"The Entirely Different Boiler and Engine Treatment"

**You can hold a whole month's supply of Sand-Banum in the palm of your hand! Ounces of Sand-Banum applied weekly keep your boilers and engines free of scale and corrosion. It's doing it for plant operators throughout the country. Consistent performance for 14 years is your assurance.**

*Write for facts today.*

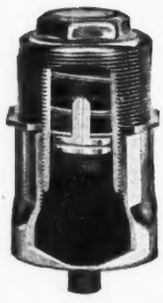
**AMERICAN SAND-BANUM CO., Inc.**
**9 Rockefeller Plaza**
**New York City**

# TRY *at our expense*

WRITE ON YOUR BUSINESS LETTERHEAD, FOR **FREE SAMPLE** OF

# HUNTER

*"Airspring" Grease Cups*



Drawn-steel, cadmium plated . . . *Never known to rust!* Standard in whole industries!

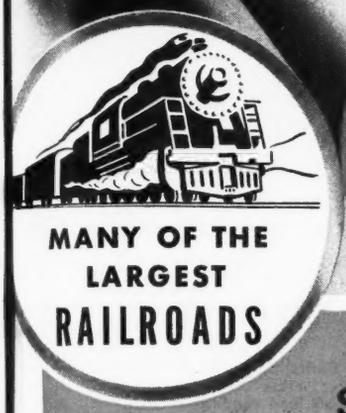
*"Shurflo" Oil Cups*

Designed for service where grit, dust or lint is a problem. A superior cup in every way. Test it; prove it!

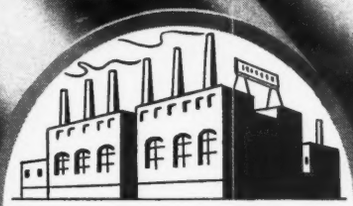
HUNTER SPRINGS - STAMPINGS

**HUNTER PRESSED STEEL CO.**
**Lansdale, Pa.**

# There must be a reason why



MANY OF THE LARGEST RAILROADS



LEADING PUBLIC UTILITIES

PROMINENT ENGINEERING CONSULTANTS

OUTSTANDING INDUSTRIAL CONCERNS

## SPECIFY AND USE REPUBLIC

# ELECTRUNITE

REG. U. S. PAT. OFF.

## ELECTRIC RESISTANCE WELDED BOILER, CONDENSER AND HEAT EXCHANGER TUBES

## -In fact, there are 6 important reasons, and here they are:

**1. Strong, safe and sound** — ELECTRUNITE Tubes are cold-formed from flat-rolled steel and electric resistance welded into a homogeneous tube with a *WELD AS STRONG AS THE WALL.*

**2. Easy to install** — Because they are *consistently UNIFORM* in diameter, wall thickness, concentricity, straightness and ductility, ELECTRUNITE Tubes slide through tube sheet holes freely and expand, prosser, roll in and bead easily. Users report up to 30% savings in installation costs.

**3. Scale-free surface** — ELECTRUNITE Tubes are full normalized in a controlled reducing atmosphere — without oxidation and *WITHOUT THE FORMATION OF SCALE.* As a result, ELECTRUNITE Tubes have a glass-like surface — entirely free from corrosion-inviting scale and scale pits.

**4. Thoroughly tested and inspected** — Samples taken at various stages in the manufacture of ELECTRUNITE Tubes are subjected to severe destructive tests, as a matter of rigid routine. Every tube is tested under hydrostatic pressure far in excess of code requirements and each tube is painstakingly inspected by a thoroughly trained "watch-dog of quality."

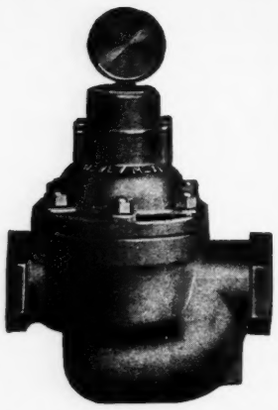
**5. Wide approval** — ELECTRUNITE Tubes meet the requirements of A. S. M. E.; U. S. Dept. of Commerce, Steamboat Inspection Service; American Bureau of Shipping; Lloyd's Register of Shipping; Association of American Railroads.

**6. Availability** — ELECTRUNITE Tubes are made in a complete range of sizes and gauges — in carbon steel, copper-bearing steel and *Toncan Iron. They are stocked by distributors in larger cities.

Why not investigate for yourself the advantages of Republic ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes? We shall be glad to send literature or to have an engineer call at your convenience. We can give you names of well-known users, too, if you wish. Write Steel and Tubes Division, Republic Steel Corporation, Cleveland, Ohio.

*Reg. U.S. Pat. Off.

# HENSZEY
## BOILER FEED WATER METERS



## will catch your LAZY BOILERS!

**Are you certain that each and every boiler does its share of the work? A boiler may appear up to standard because it uses the *same* amount of fuel as the others. But that one boiler may be doing only a small part of the work while the others in the line are being overworked.**

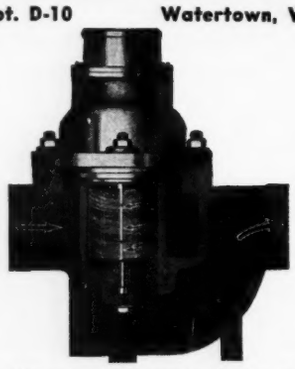
**A Henszey Boiler Feed Water Meter installed in the feed line of every boiler will immediately point out which boilers are lagging and which ones are being overworked. This is because the Henszey Meter records every drop of water that is fed to each boiler—a record to show you exactly how much of the steam each boiler is producing.**

**The Henszey Boiler Feed Water Meter is equally accurate at high or low flow, on centrifugal or reciprocating pumps, and at all pressures and temperatures. Henszey Meters are saving money for operators in hundreds of power plants in 43 states and seven foreign countries.**

***Send for complete information***

## HENSZEY COMPANY

**Dept. D-10 Watertown, Wis.**



**The water enters the measuring chamber tangentially, as indicated in the cutaway view above. The water spins in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register.**

## HENSZEY


bine is rated 48,000 hp at 81.8 rpm with a 43-ft head. This order makes the Pickwick Landing Dam project 100% equipped with Allis-Chalmers hydraulic turbines.

The Wilson Dam project—built during the World War for nitrogen production and known at that time as Muscle Shoals—will have, with the completion of this order, twelve units installed. The two hydraulic turbines for which this contract calls are each rated 35,000 hp at 100 rpm with a head of 92 ft. The two generators are 28,000 kva, 13,800 volts at 100 rpm and are of the so-called umbrella type. The peculiarity of this type is that the arms of the rotor bend down like the ribs of an umbrella, giving a low, compact, stable machine.

## PERSONALS

J B Morrow has been elected president of Pittsburgh Coal Co, Pittsburgh, Pa., to succeed J D A Morrow, who will continue to serve the company as a member of the board and the executive committee.

Clifford Strock, associate editor of *Heating & Ventilating* for the past 12 years, has been made editor. Joseph Kern, Jr, assistant editor, becomes associate editor. C H B Hotchkiss, former editor, has resigned to become vice-president and director of Ameresco, Inc, export representatives for heating and ventilating equipment. He will continue with the magazine in capacity of contributing editor.

Christian Wilson, Jr, has been appointed sales representative of Yarnall-Waring Co, operating from offices in the Wabash Bldg, Pittsburgh, Pa. Mr Wilson was formerly in the Yarway New York office.

J A Butler has been appointed comptroller of Falk Corp, Milwaukee, Wis. He is a native of Minnesota and a graduate of Hamlin University in St. Paul. He has been with the present company for four years.

Professor Dr Ing Ernest Kraft, one of the world's pioneers of steam-turbine construction, celebrated his 60th birthday

## MEETINGS

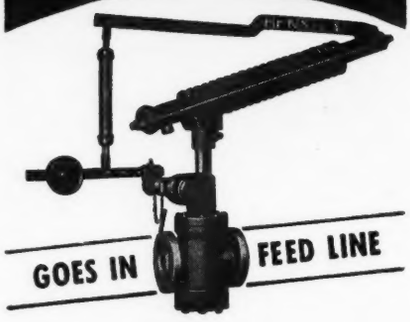
**American Society of Heating and Ventilating Engineers**—*Fall Meeting, October 14–15, Rice Hotel, Houston, Texas. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

**American Society of Mechanical Engineers**—*Joint Meeting, ASME Fuels Div and AIME Coals Div, November 7–9, Hotel Tutwiler, Birmingham, Ala. C E Davies, secretary, 29 W 39 St, New York, N. Y.*

**National Electric Mfrs. Assn.** — *Annual Meeting, October 27–November 1, Waldorf-Astoria Hotel, New York, N. Y. W J Donald, director, 155 East 44th St, New York, N. Y.*

**New York Power Show** — *Grand Central Palace, New York, N. Y., December 2–7, 1940. Management, International Exposition Co., New York, N. Y.*


# HENSZEY
## BOILER FEED REGULATORS




**The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!**

**These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order — nothing to reset.**

***Send for latest Bulletin containing full details.***

## HENSZEY COMPANY

**Dept. D10—Watertown, Wis.**

# "STANDCO" PILLOW BLOCKS

Fig. 1635

**Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.**

Fig. 32

**"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.**

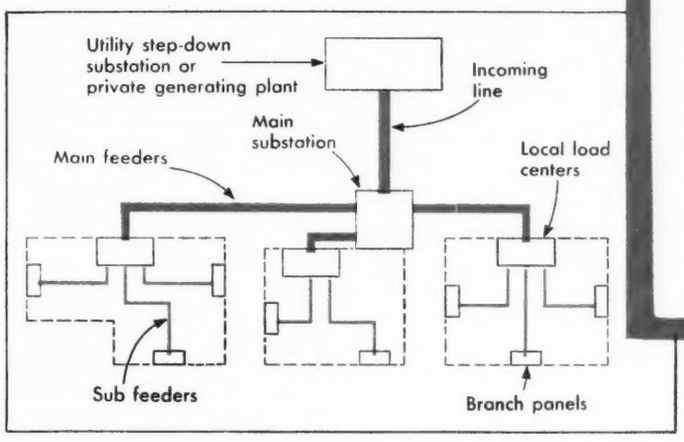
***Write for Bulletin***

## STANDARD PRESSED STEEL CO.

**JENKINTOWN, PENNA.**

**Boston Detroit Indianapolis Box 577 Chicago St. Louis San Francisco**

# No. 1799 VC CABLE Has Proved Its VALUE for INDUSTRIAL POWER WIRING




**For main feeders in industrial plants and large buildings: where a load from 200 to 500 kw is to be distributed from the power company substation at, say, 13,200 volts, down through 2300 volts, to 440 or 220 or 110.**

FOR such requirements, varnished-cambric cable is often the logical choice, from both the technical and economic standpoints. For example, in one large steel mill there are eight main 12,000-volt power feeders run with armored 600,000-cir-mil G-E varnished-cambric cable.

Such feeders are important circuits. They supply power to processes and operations that if stopped for only a moment would entail heavy losses. For such service, varnished-cambric cable has proved its value. In thousands of industrial plants it has proved its ability to maintain continuity of service at low cost.

### Now, Temperature: 85 C

Retaining all the good properties that made our former standard No. 995 so reliable, the new No. 1799 varnished-cambric has in addition extra heat resistance. The cable can be run at 85 C, approximately 10 C higher. This means possible reductions in conductor size, and thus in copper—particularly on low-voltage lines—with corresponding reductions in first cost, over-all diameter, weight, and space.

### Every Type Available

Cable insulated with No. 1799 varnished cambric is available in all types: braided, leaded, interlocked and other armored types, nonshielded and shielded, for voltages from 600 to 27,000. If there is any question as to which type is best adapted for a particular job, a G-E cable specialist will gladly make recommendations. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

500-9

# HOW DO YOU STEER YOUR CONDENSATE?

It does not need Soda or Lime . . . or filtering.

If needless steps are used, it may pick up contamination.

But it does need De-Aeration.

If your water softening system has the de-aerator located anywhere except in the logical phase, you are not de-aerating the efficient way.

The American Ultro-Therm De-Aerator is logically located . . . it conserves heat (steam) . . . maximum of thermal efficiency . . . every unit of the heat of the steam is put to work.

It conserves space . . . no additional space required . . . it is an integral part of the American Hot Process Softening Plant.

Complete details are in Bulletin #111.

**SEND for THIS BULLETIN TODAY**

*The* **AMERICAN WATER SOFTENER COMPANY**

**WATER REFINING EQUIPMENT HEADQUARTERS**

INDUSTRIAL • PROCESS • RAILROAD • MUNICIPAL HOUSEHOLD, ETC.

**322 LEHIGH AVE., PHILA., PA.**

**The AMERICAN WATER SOFTENER CO.**
**WATER REFINING EQUIPMENT HEADQUARTERS**
INDUSTRIAL • PROCESS • RAILROAD • MUNICIPAL HOUSEHOLD, ETC.
**322 LEHIGH AVENUE, PHILA., PA.**

Please send me a copy of Bulletin No. 111

Name_____

Address_____

City_____ State_____


recently. Dr Kraft is in charge of the AEG (German General Electric Co) works in Berlin.

WILLIAM P LASETER has been appointed export manager of the Export Div, John A Roebling's Sons Co, to have offices at 19 Rector St, New York. Mr Laseter was formerly assistant export manager for Oil Well Supply Co.

DR W D COOLIDGE, director of General Electric's Research Laboratory, has been named to the newly organized National Inventor's Council, a body created by Secretary of Commerce Harry Hopkins to encourage civilian inventions as part of the national defense program. The council, composed of 12 scientists and industrial leaders, will co-operate with the National Defense Research Committee.

R VOLBRECHT has been appointed to the New York merchandising sales staff of Cutler-Hammer, Inc. Mr Volbrecht joined the organization upon his graduation from the University of Wisconsin, spent a number of years at the company's main plant in Milwaukee, and some time in the Motor Control Sales Div of the Philadelphia District office.

F GEIGER has been appointed assistant manager of the Electrical Dept, Allis-Chalmers Mfg Co, in which capacity he will be in charge of sales and engineering at the company's Norwood, Ohio, plant. Frank R Freyler, now in Philadelphia, Pa., office, will be transferred to the Norwood plant to take over duties left by Mr Geiger.

CHESTER H NORTON, purchasing agent at Allis-Chalmers' Boston Works, has been appointed assistant general manager of purchases. He has been transferred to the company's main offices in the West Allis Works, Milwaukee, where he will assist Fred E Baker, general manager of purchases for the company.

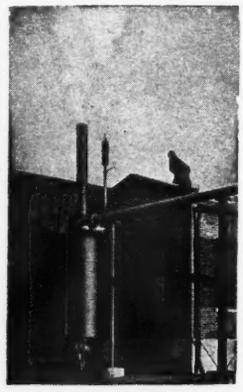
## OBITUARIES

WILLIAM L FEWSMITH, 61, manager of publicity and advertising for Robins Conveying Belt Co, Passaic, N. J., died August 15 after a brief illness while on vacation at Port Carling, Ontario, Canada. Mr Fewsmith was appointed head of the Publicity and Advertising Department in 1924. He was a member of the National Industrial Advertisers Assn, and the ASME.

A C W GAGE, purchasing agent for British Columbia Electric Railway Co, died at his home in Gibsons Landing, B. C., recently. Mr Gage first came to Canada in 1906 from Ireland, and was with the present company for 29 years. He joined the company in 1911 in the Stores Department, and in 1916 was transferred to the Purchasing Dept. He was made assistant purchasing agent in 1922, and was promoted to purchasing agent in 1929.

SIDNEY BORDEN PAINE, 84, retired manager of Mill Power Dept, General Electric Co, said to be one of the foremost authori-


# MAXIM SILENCERS



**FOR EVERY INDUSTRIAL SILENCING PROBLEM**

**Maxim Silencers cover nearly every conceivable industrial silencing problem . . . high or low pressure steam discharges, internal combustion engine exhaust or intakes, compressor intakes, blowers, etc.**

***Write for details***

**THE MAXIM SILENCER CO.**
**92 Homestead Ave. Hartford, Conn.**

**300 SPECIALTIES FOR POWER PLANTS-*standard since 1872***

**For PROMPT Delivery**

Pop Safety Valves; Relief Valves; Pressure Gauges; Ammonia Gauges; Hydraulic Gauges; Water Gauges; Chime Whistles.

Also Plain Whistles and Whistle Valves, Vacuum Gauges, Steam Gauge Syphons, Revolution Counters, Marine and Engine Room Clocks, Lubricators and Oiling Devices.

Also manufacturers of Sight Feed Oil Cups, Cylinder Sight Feed Lubricators, Multiple Oilers, Cylinder Oil Pumps, Grease Cups and Oil Level Gauges.

**Lonergan**

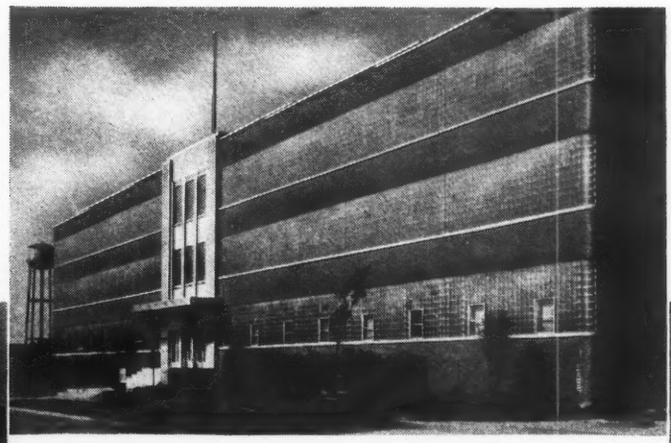
**GAUGES • VALVES • SPECIALTIES**

• WRITE for CATALOG.

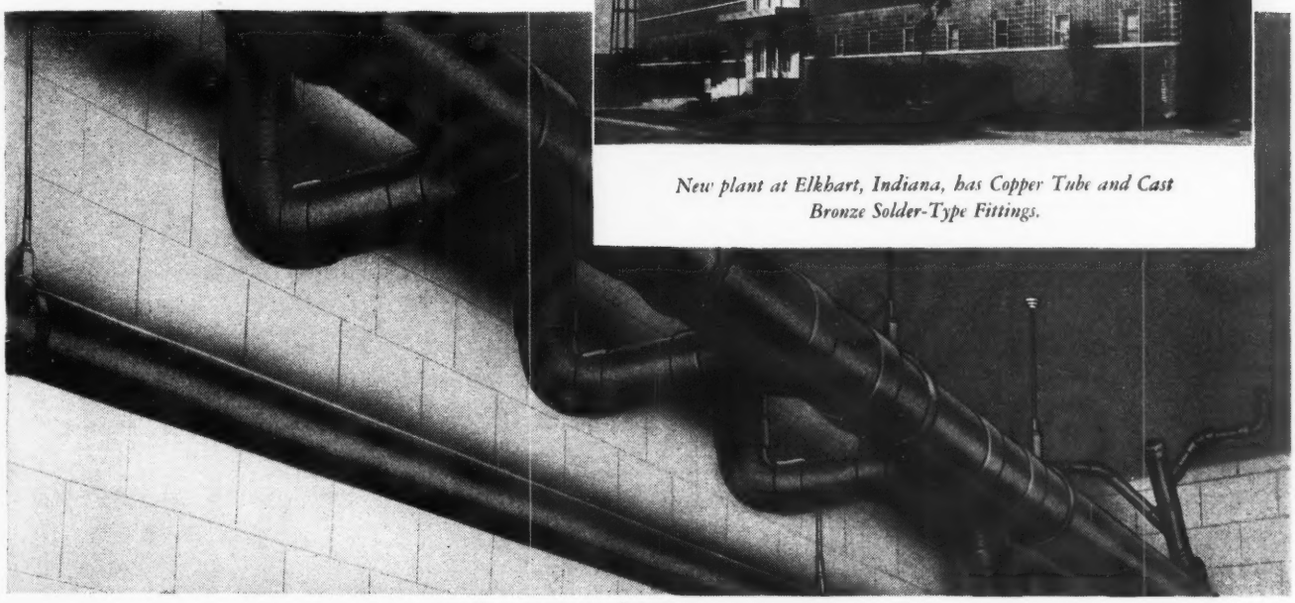
**J. E. LONERGAN COMPANY**
RACE & SECOND STS. PHILADELPHIA, PA.

# NO PIPE HEADACHES

## for makers of ALKA-SELTZER



*New plant at Elkhart, Indiana, has Copper Tube and Cast Bronze Solder-Type Fittings.*



*Anaconda Type K Copper Tubes in sizes from 3/8" to 8" were used for all plumbing, heating, and waste lines in this new plant of Miles Medical Laboratories.*

IN THIS NEW ultra-modern home of the world-famous Alka-Seltzer, Anaconda Copper Tube provides economical assurance of high efficiency and long life.

Significant to all industry is the fact that the installed cost of copper tubes in the smaller sizes is scarcely more than that of rustable piping; and, with the larger sizes, space savings effected by compact fittings often more than compensate for the higher material cost. These low cost factors, plus rust-free service and the elimination of rust repairs, mean that in countless cases Anaconda Copper Tube is the most economical piping material obtainable.

Do as the makers of Alka-Seltzer did and get lasting relief from piping headaches. Use Anaconda Copper Tube. It's available in all standard sizes and wall thicknesses, and is carried in stock by wholesale distributors the country over. 4003A

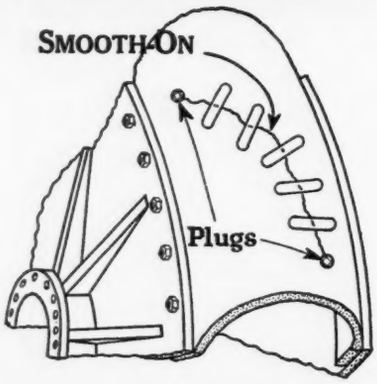
ANACONDA
from mine to consumer

*Anaconda Copper Tubes*

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

*Offices and Agencies in Principal Cities* • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

**EMERGENCY REPAIRS**
quickly and at low cost




***Save time, labor and replacement expense***

**Cracked machine parts and leaking joints and pressure vessels can be returned to full service speedily and economically with Smooth-On No. 1. Smooth-On is easily applied, forms a pressure-tight seal, is not affected by steam, water, oil or gas, and withstands vibration.**

***Buy Smooth-On No. 1 in 1 or 5-lb. can or 25-lb. keg from your supply house or if necessary direct from us. For your protection, insist on Smooth-On, used by engineers and mechanics since 1895.***

40 Pages
170 Illustrations

**FREE**

The Smooth-On Handbook which explains how to make dozens of repairs to plant equipment. Its practical suggestions are based on the experience of thousands of engineers. Be sure to write for your copy today.

SMOOTH-ON MFG. CO., Dept. 30
570 Communipaw Ave., Jersey City, N. J.
Please send SMOOTH-ON HANDBOOK.

Name .....
Address .....
.....
10-1-40 .....

***Do it with***
**SMOOTH-ON**


ties in the world on textile mill electrification, died in Auburndale, Mass., on August 15. He was widely known in the electrical and power industries for his pioneer work in motor applications.

CHARLES FREDERICK DREW, secretary and treasurer, Rust Engineering Co, Pittsburgh, Pa., died August 4.

MILO SMITH LONG, 54, engineer in Nashville, Tenn., office of United States engineers, died in Murfreesboro, Tenn. He was formerly connected with the Alabama Power Co.

FRED B STIVER, 59, safety inspector for Union Electric Co, and a member of the St Louis safety council, died August 22 following an illness.

STEPHEN JOSEPH GARAHAN, 53, manager of sales for wire and cable section of General Electric's Central Station Dept, died at Ellis Hospital, Schenectady, N. Y., Sept. 5. Mr Garahan joined General Electric Co in 1904 as an employee in the Shipping Dept of the Schenectady Works. He was transferred to the Wire and Cable Dept in 1909 and became assistant to head of that dept in 1923. In 1929 he was placed in charge of cable quotations, and later was made assistant manager of cable sales. He was appointed manager of cable sales in 1936.

## BUSINESS ITEMS

UNIVERSAL GEAR CORP, Indianapolis, Ind., announces appointment of Sintes Salles Engrg Co, New Orleans, La., as representative in Louisiana, southern part of Mississippi and Mobile section of Alabama.

KIRK & BLUM MFG CO, Cincinnati, Ohio, is now celebrating a third of a century of business. The company started in 1907 with a small shop, and expanded from that into its present plant covering two acres. Company has specialized in planning, fabrication and erection of dust-control systems, ventilating and cooling systems, and, since 1924, industrial drying and baking ovens.

CALLITE TUNGSTEN CORP, Union City, N. J., has added approximately 100,000 sq ft of floor space to its facilities through acquisition of large factory property adjacent to present plant.

Personnel changes at GREENFIELD TAP & DIE CORP, Greenfield, Mass., include election of president Donald G Millar to chairman of the board, replacing Col Frederick H Payne, who resigned to take up duties as chief of Hartford Ordnance District. Mr Millar was succeeded as president by Howard M Hubbard, of Cleveland, Ohio. Company has also accepted resignation of Francis A Smith, who left after more than 20 years service with company.

Floyd Stroup and Craig Hampton have been made superintendent of Melt Dept, and superintendent of maintenance, re-


**HOT OFF THE PRESS!**

**Send for Your Copy of This New**

**AJAX**

**DATA BOOK**

**Every plant man responsible for keeping wheels turning should have a copy of this new valuable data book showing complete line of Ajax Flexible Couplings. It contains useful technical information concerning applications and load capacities of Ajax Flexible Couplings for light, medium, heavy duty and special installations.**

**"Inside out" pictures show how Ajax couplings protect expensive machinery and keep it running by combining—**

**Positive Drive**
**Resilient Flexibility**
**Protection Against Misalignment**

**Free End Float**
**No Noise, No Backlash**
**No Lubrication**

*Write for your personal copy today*

**AJAX FLEXIBLE COUPLING CO.**

132 English St. Westfield, N. Y.

Incorporated 1920
*Sales Offices in All Principal Cities*

# "A RECORD FOR CONSTANT OPERATION"

*Trouble-free turbine means trouble-free operation for prominent fuel company.*

*A case history showing the trouble-free service you can expect wherever you see the Coppus* **BLUE RIBBON**

"This turbine pump has performed 24 hours a day for more than three years and has never been shut down... is still operating 24 hours a day, and we have never had any maintenance cost of any kind on either turbine or pump. This is a record for continuous operation for any piece of machinery we have ever installed."

To insure consistently dependable operation of turbine-powered equipment, write "Coppus" on your specification. The "blue ribbon" painted on the flange indicates:

1. **PRECISION WORKMANSHIP**—controlled by Johansson size blocks.
2. **ENCASED GOVERNOR**—slow speed, leverless.
3. **SEPARATE SAFETY TRIP**—pilot-operated, leverless.
4. **PARTIAL LOAD ECONOMY**—by individual nozzle control.
5. **DYNAMOMETER TESTED**—before shipment.

During 1939, 87% of orders for Coppus Steam Turbines were repeat orders. Bulletin 135-9 describes vertical and horizontal types; also with built-in speed reducer. Steam, air or gas-operated. Write for this bulletin today.

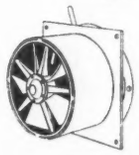
**H. P. not E. P.* for small H. P. jobs.**

*Elephant Power—a large-size turbine for a job a small-size Coppus could handle. Save investment cost with a Coppus Turbine sized close to your needs.

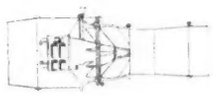
**COPPUS ENGINEERING CORP.**, 350 Park Ave., Worcester Mass. Sales offices in THOMAS' REGISTER. See SWEET'S for other "Blue Ribbon" products—air filters, gas burners, blowers, ventilators, fans.

## COPPUS BLUE RIBBON PRODUCTS

*Designed for your Industry*
*Engineered for You*

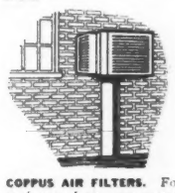


**COPPUS-DENNIS FANMIX GAS BURNER.** New method of mixing gas and air insures perfect gas-air ratio—instant, complete combustion. Bulletin 410-2.



**COPPUS VANO BLOWERS.** 1001 uses. High efficiency on special installations where ordinary fans fail. Bulletin 115-6.

**COPPUS CABLE MANHOLE AND TANK VENTILATORS.** For any confined working space. Special adaptions for boilers, tank cars, shipholds. Bulletin 163-1



**COPPUS AIR FILTERS.** For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4

# COPPUS

ADVERTISING PAGES REMOVED

# PAYS FOR ITSELF QUICK!—CRYER STEAM TRAP

Install a CRYER and it will pay for itself quickly in steam savings and through increased efficiency in steam distribution. Eliminates air-binding. Guaranteed for performance.

All mechanism removable without disturbing piping (saving maintenance). All wearing parts of stainless steel (maximum in life and minimum repairs). Installation simple (requiring no special support). Venting quick and positive, (fast action, dependable drainage).

AIR TRAPS for draining water from air lines furnished with quick venting valve omitted.

In short all time and money-saving features you want are yours in the CRYER INVERTED BUCKET STEAM TRAP.

Sizes from ½" to 2½". Capacities from 500 to 38,000 pounds of water at pressures from 0 to 250 pounds.

INVESTIGATE TODAY—Send for complete detailed information.

## CRYER TRAP & VALVE CO., INC.

*Manufacturers of Steam Specialties for more than 40 years.*

**366 Madison Ave., New York, N. Y.**

# Delray Uses NUGENT FILTERS

NUGENT TRADE MARK

**TO insure an ample supply of clean lubricating oil for three 75,000 KW. and three 50,000 KW. turbines, the Delray Extension of The Detroit Edison Company installed a Nugent Oil Filter.**

**"Nugent equipped" means modern and safe lubrication which saves machines and oil. That is why engineers in central stations and manufacturing plants specify Nugent Systems for turbines, steam or oil engines, air compressors, refrigerating and other power equipment.**

**Take advantage of Nugent Oil Filter savings in your plant. Mail the coupon today for full details.**

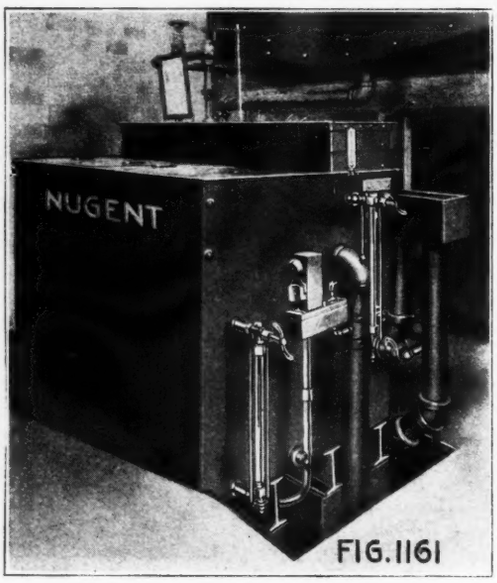



FIG. 1161

● View of installation of 880 gal. per hr. Nugent Oil Filter in Delray Station No. 3 of The Detroit Edison Company.

Wm. W. Nugent & Co., Inc.
402 N. Hermitage Ave., Chicago, Ill.

Please send literature and information covering: ☐ Diesel Engine Fuel Oil Filters. ☐ Diesel Engine Lube Oil Filters. ☐ Turbine Oil Filters. ☐ Sight Feed Bearing Oilers. ☐ Telescopic Eccentric Oilers.

Name.....

Company.....

Address.....

**WM. W. NUGENT & CO., INC.**
Established 1897
**402 Hermitage Ave., Chicago, Ill.**

spectively, of COPPERWELD STEEL Co's new plant at Warren, Ohio.

GREENE, TWEED & Co, New York, announces addition of John N Harper and Joseph H Maloney to its staff. Mr Harper will be stationed in Pittsburgh to cover western Pennsylvania territory and Mr Maloney will cover the northeastern Ohio territory from Cleveland.

RELIANCE ELECTRIC & ENGRG Co is opening a sales office in Houston, Texas. Frank A Denison has been appointed district manager. He was formerly in the Detroit office of the company, where he had been a member of the sales engineering staff since early 1937.

LUIPPOLD ENGINEERING SALES Co, Los Angeles, has been appointed representative of Simplex Valve & Meter Co, in Southern California and Arizona.

PITTSBURGH PIPING & EQUIPMENT Co, Pittsburg, Pa., announces that G Sinding Larsen has been elected a director of the company. Mr Larsen entered the company in 1934 and was appointed chief engineer in 1938.

# Current Comment

## Don't Forget Industrial Power

THE EDITORIAL in August, 1940, POWER, "Power for Defense," is a "honey." The general public has some very strange notions about this whole power business, and strange to say, these "snap-judgment" notions are not confined to the uninitiated, non-technical minds. One paragraph of your discussion hits the nail on the head, and is worth repeating.

"The persistent tendency, even of the 'experts,' to think of industrial power exclusively in terms of central electric supply, is a strange and dangerous phenomenon."

In the language of the street, you said a mouthful there. Looking at our defense problem cold-bloodedly, undoubtedly the most vulnerable part of our whole interior machine is the vast amount of power tied up in a comparatively few central power plants, and coupled to this is the fact that this tremendous amount of power can only be delivered to the users by the use of a more or less flimsy system of exposed and easily accessible high-tension transmission lines. It requires no argument to convince any one who knows what it is all about that this centralized power business is very vulnerable.

As you put it, "don't forget the industrial power plant," and to this I say Amen. The government should look to its own more important buildings with the view of producing its own power for reasons of safety. Take for instance the arsenals, Navy yards, hospitals, the Army camps and supply depots, and numerous other Government buildings. By all means, the

# WATER TEMPERATURES
## ARE ONE FACTOR IN CHOOSING CONDENSER TUBE ALLOYS

### A BRIDGEPORT ENGINEER CAN HELP YOU EVALUATE ALL FACTORS

Temperature of circulating water is vitally important in the life of condenser or heat exchanger tubes. When tubes are first placed in service, a rapid chemical action may occur, which builds a protective film over the metal. Cool water is more apt to permit the formation of a strong, uniform film; but warm water, which encourages marine growths, carries more decomposing vegetable matter and gases, which sometimes inhibit the building of this film.

Your water temperature is just one of the many variables which you must consider when selecting your correct tube alloy. Other important considerations are changing factors of pollution, turbulence and velocity.

Only broad field experience can properly evaluate all these conditions. That is why so many power plants, marine installations, and oil refineries call on the wide knowledge of a Bridgeport Condenser Engineer to supplement their own.

His first-hand experience with almost every variety of condenser and heat exchanger problem has brought him a wealth of practical information he will be glad to share. You will find his assistance invaluable in choosing the condenser tube or heat exchanger alloy that will strike the right balance between low initial cost and long operating life.

"Bridgeport" BRASS

# BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN. • ESTABLISHED 1865

**WRITE FOR YOUR COPY**

BRIDGEPORT BRASS COMPANY,
Condenser Tube Engineering Dept. C.
Bridgeport, Conn.

☐ I'd like to have a copy of the new revised "Condenser Tube Manual."

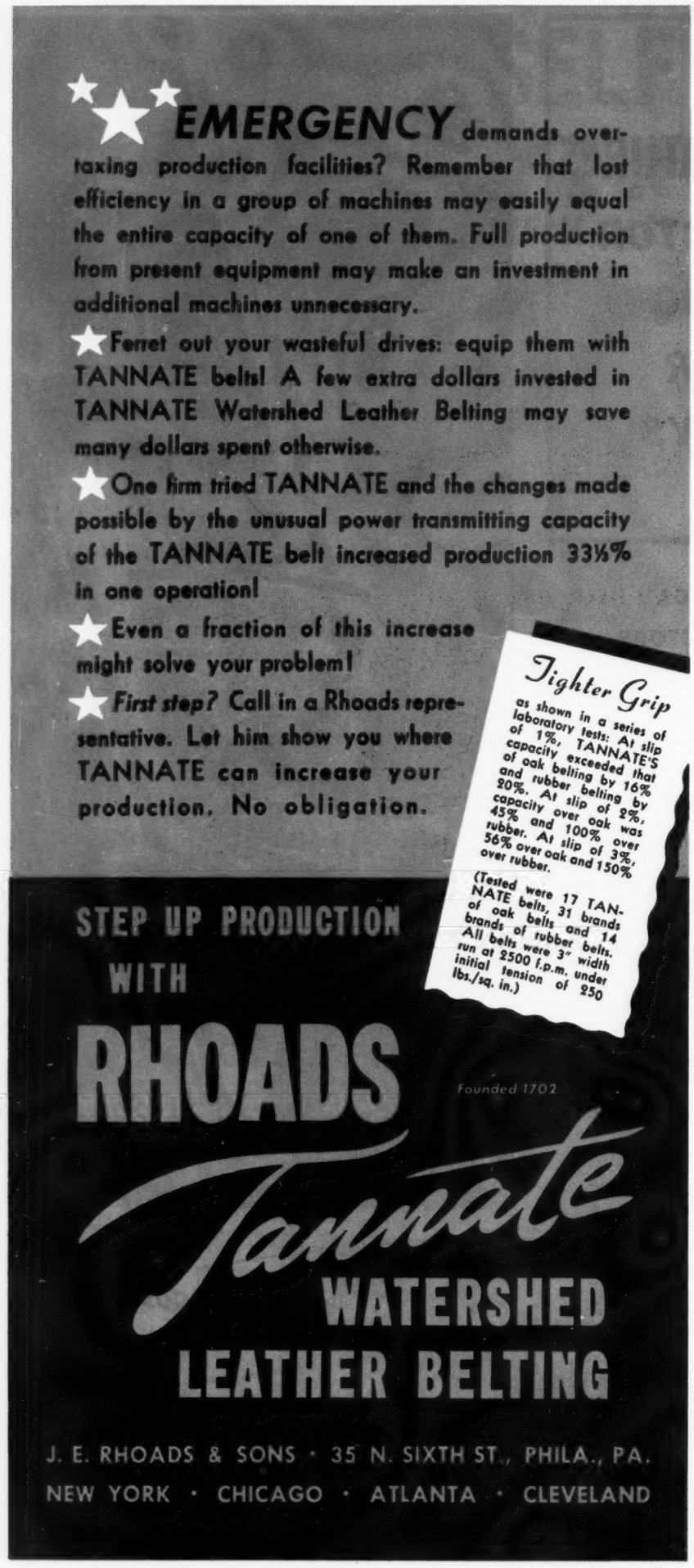
☐ I'd like to talk to one of your condenser engineers about my problem.

NAME .....

COMPANY ..... TITLE .....

ADDRESS .....

CITY ..... STATE .....


EMERGENCY demands overtaxing production facilities? Remember that lost efficiency in a group of machines may easily equal the entire capacity of one of them. Full production from present equipment may make an investment in additional machines unnecessary.
Ferret out your wasteful drives: equip them with TANNATE belts! A few extra dollars invested in TANNATE Watershed Leather Belting may save many dollars spent otherwise.
One firm tried TANNATE and the changes made possible by the unusual power transmitting capacity of the TANNATE belt increased production 33⅓% in one operation!
Even a fraction of this increase might solve your problem!
First step? Call in a Rhoads representative. Let him show you where TANNATE can increase your production. No obligation.
Tighter Grip
as shown in a series of laboratory tests: At slip of 1%, TANNATE'S capacity exceeded that of oak belting by 16% and rubber belting by 20%. At slip of 2%, capacity over oak was 45% and 100% over rubber. At slip of 3%, 56% over oak and 150% over rubber.
(Tested were 17 TANNATE belts, 31 brands of oak belts and 14 brands of rubber belts. All belts were 3" width run at 2500 f.p.m. under initial tension of 250 lbs./sq. in.)
STEP UP PRODUCTION WITH
RHOADS
Founded 1702
Tannate
WATERSHED
LEATHER BELTING
J. E. RHOADS & SONS · 35 N. SIXTH ST., PHILA., PA.
NEW YORK · CHICAGO · ATLANTA · CLEVELAND

Government properties should be free from the obvious risks of non-predictable interruptions of power.

Another feature of the independent power plant that has been generally overlooked is its economic aspects in our general power problem. The business of producing and publicly vending electric power and light is a highly competitive business. The general public does not realize this, and sad to relate, many people within the Government are not aware of this condition either.

When we say that the centralized power business is highly competitive, we do not mean that this competition comes about from two or more centralized power companies competing with one another in the same territory. What we mean is that the private power plant has done more to force down electric power rates than all the utility regulation in the country.

The privately owned electric power plant obviously has a permanent place in our economic structure and manifestly it also has a very important place in our National Defense. The electric public utility has its place in our economic machine, but it also has its limitations.

The political engineers have built up a beautiful myth about the so-called power trust and the gullible public has swallowed it "hook, line and sinker." Whether the power trust is a myth or a real thing, it has served as a real instrumentality for the politicians to make several handsome raids on our National Treasury under the pretext of proving that privately produced and publicly vended electric power is too costly.

*E Orange, N. J.* EGBERT DOUGLAS

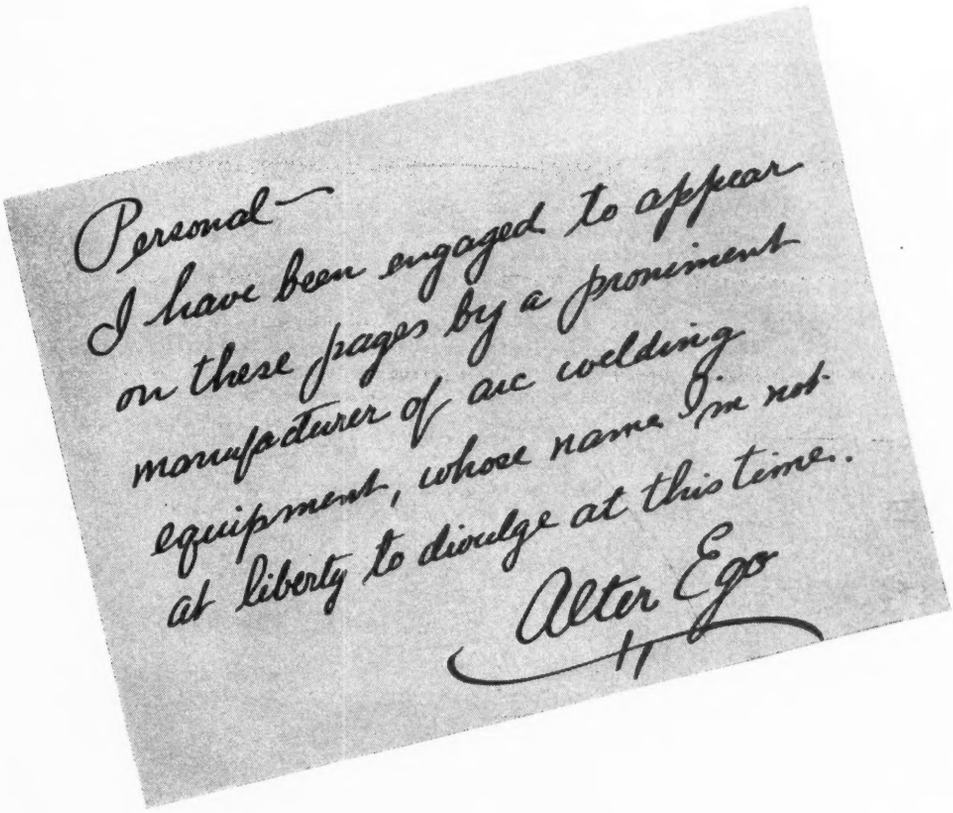
## An Engineer in Politics Looks at Apprenticeship

EVERY BUSINESS MAN wants employees who really know their jobs. Engineers in power and other industries not only want them; they *have* to have them. For engineering, above all others, is a profession in which mistakes are more than costly; they are all too often fatal.

In 20 years of experience as an engineer, before I became a member of the New York State Senate, I learned thoroughly, as every engineer must, the difference between good workers and bad. And I became a staunch adherent of the apprenticeship system, the best technique yet devised for producing the good ones and getting rid of the bad ones.

Seventy-five years ago apprenticeship was flourishing in this country, and American workmen were as good as any in the world. Unrestricted immigration dealt this time-honored system a mortal blow; hundreds of thousands of European-trained workmen flooded the labor market. There was an abundance of skilled men of every kind, and American industry largely ceased the job of training its own.

In 1924, unrestricted immigration came to an end, but by this time the very traditions of apprenticeship were almost forgotten. The vocational school, in theory, took its place. Employers discovered, however, that there were serious shortcomings in the functioning of the voca-


Personal—
I have been engaged to appear
on these pages by a prominent
manufacturer of arc welding
equipment, whose name I'm not
at liberty to divulge at this time.
Alter Ego

**ECLIPSE**
**SEAMLESS FLEXIBLE METAL HOSE**

*Normal Pitch*

Of seamless, all metal, parallel corrugated, armored construction, in various alloys with renewable type fittings approved for the conveyance of non-solids and non-abrasives in *Aviation, Automotive, Marine, Heating, Air Conditioning, Mining, Power Generation, Plastic and Textile applications* wherein conditions of flexing and expansion between delivering and receiving connections exist. Also available for shielding and exhaust applications.

*Close Pitch*

*"Listed by Underwriters' Laboratories"*

METAL HOSE DEPARTMENT
ECLIPSE AVIATION, BENDIX, N. J.
DIVISION OF BENDIX AVIATION CORPORATION

**TOUGH REPAIR for BROKEN CONCRETE**

Avoid accidents! Prevent costly delays! Repair holes, cracks, broken places in concrete floors or resurface an entire area with the durable RUGGEDWEAR RESURFACER. No chopping or chipping required. Merely sweep out spot to be repaired—mix the material—trowel it on. Holds solid and tight right up to irregular edge of old concrete. Cellulose-Processed to provide a firmer, tougher, smoother, more rugged wearing surface. Used indoors or out. Dries fast. Costs only 10c to 14c per sq. ft.

*Valuable 68-page "HAND BOOK OF BUILDING MAINTENANCE" available to those requesting on business letterhead.*

**MAKE THIS TEST!**

FLEXROCK COMPANY
2377 Manning St., Phila., Penna.
Please send me complete RUGGEDWEAR information . . . details of FREE TRIAL OFFER —no obligation.

Name .....
Company .....
Address .....
City..... State.....


tional school system; its graduates were not "work-minded" or "industry-minded"; the training was inadequate, rigid, standardized, and the whole set-up was in many respects unrealistic. Experience on the job was the only answer, and employers began to think once more about the advantages of apprenticeship.

But there were new deterrents now. In a zealous and laudable attempt to safeguard minors from exploitation and abuses by unscrupulous men, a network of legislation had grown up which made employment of young people as "learners" too costly and dangerous for most industrialists. Rigidly administered state and Federal laws regulating wages, hours, social-security payments, workman's compensation and the like made employers feel that they could not afford to take on apprentices. Some of the largest companies, such as General Electric, set up successful apprentice plans, but this was rare indeed.

What are the results today? Every newspaper proclaims them. Labor shortage. "Bottlenecks." Danger to the national defense program. And frantic haste on the part of all concerned to make up for lost time.

Already certain facts about present-day apprenticeship are becoming clear. It should be built from the bottom up, not from the top down. Although the Federal government may assist with advice and encouragement, and the State government exercise a general supervision over standards, really sound apprentice programs are locally organized and locally controlled. Industrialists and business men generally must take the lead, cooperating with educational authorities and labor leaders to set up workable systems adapted to local conditions. The vocational school plays its necessary part in the training of the younger worker through a program of related subjects supplementing his practical work on the job. The apprentice should be considered as a "learner" rather than an "employee," as defined by the various labor laws.

Recently, in my capacity as State Senator, I called a conference in Albany to discuss apprenticeship. Leading men in industry, educators and labor representatives were present. Their interest and enthusiasm was unbounded; out of the conference came suggestions and practical plans for stimulating apprenticeship throughout the state of New York. It is up to responsible industrial leaders everywhere to take the initiative now in calling similar meetings. They will find public officials more than eager to cooperate in every possible way in getting properly planned apprenticeship programs under way in every city and town where industrial conditions make this possible.

We have two armies to train, each indispensable, each interdependent. Only one can be trained by the government for the national defense; the grave responsibility for the training of the other army, the army of workers, falls primarily on the leaders of business and industry. There is no time to fumble; no time to lose. In the long run, employers will discover that, in adopting apprenticeship, patriotism goes hand-in-hand with production and profits.

*Newburgh, N. Y.* THOMAS C DESMOND
*N. Y. State Senator*

## Use Care in Welding Hollow Pistons

I WAS VERY MUCH INTERESTED in reading the article in June POWER entitled "Welding Cuts Compressor - Repair Costs," but I failed to find any mention in the article regarding the precaution that should be exercised in working

## BUZZARDS ROOST

**Recently put into operation, the Buzzards Roost hydroelectric project of Greenwood County, S. C., consists of an earth dam 2000 ft long and 85 ft high, a spillway and a power house. The latter contains three 7400-hp at 60-ft-head, Baldwin Southwark vertical Kaplan turbines operating at 240 rpm. These drive three General Electric, 6250-kva, 4150-volt, 60-cycle generators**

# 1941 MODEL *Elgin* WATER SOFTENER

# GIVES A 25% INCREASE IN WATER SOFTENING EFFICIENCY

**LOWER In Cost Capacity Considered**

•

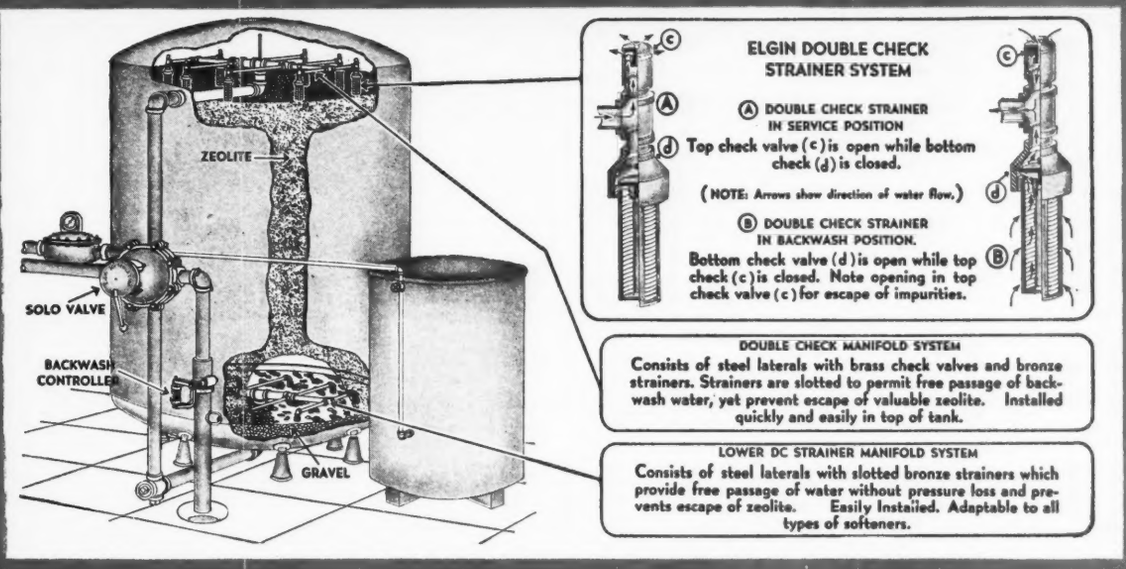
**CUTS Operating Expense**

•

**GIVES Increased Soft Water Output**

•

**Made Possible By THE EXCLUSIVE ELGIN DOUBLE-CHECK SYSTEM**


ZEOLITE
SOLO VALVE
BACKWASH CONTROLLER
GRAVEL
ELGIN DOUBLE CHECK STRAINER SYSTEM
Ⓐ DOUBLE CHECK STRAINER IN SERVICE POSITION
Top check valve (c) is open while bottom check (d) is closed.
(NOTE: Arrows show direction of water flow.)
Ⓑ DOUBLE CHECK STRAINER IN BACKWASH POSITION.
Bottom check valve (d) is open while top check (c) is closed. Note opening in top check valve (c) for escape of impurities.
DOUBLE CHECK MANIFOLD SYSTEM
Consists of steel laterals with brass check valves and bronze strainers. Strainers are slotted to permit free passage of backwash water, yet prevent escape of valuable zeolite. Installed quickly and easily in top of tank.
LOWER DC STRAINER MANIFOLD SYSTEM
Consists of steel laterals with slotted bronze strainers which provide free passage of water without pressure loss and prevents escape of zeolite. Easily Installed. Adaptable to all types of softeners.

## TOMORROW'S WATER SOFTENER . . . . . TODAY

Here is a startling new water softening principle—as revolutionary, when compared with the ordinary softener, as today's streamlined motor car compared with a 1910 automobile. A new principle originated by Elgin—the "double-check" principle—has been incorporated in the advanced 1941 model Elgin Water Softener which increases its output 25% and more. Even more startling is the fact that this Double Check System can be applied to old softeners, giving them a remarkable increase in capacity and efficiency.

## YOUR SOFTENERS CAN BE MODERNIZED WITH THE ELGIN DOUBLE CHECK SYSTEM

This system, in either a new softener or when applied to an old one, is especially welcome for installations where space is limited because it enables a softener of smaller size to give as much soft water as a unit of larger size. The idea of rebuilding existing equipment by applying the double-check principle likewise solves the problem for those plants where additional soft water is required.

## READ WHAT USERS SAY ABOUT IT . . .

O. F. BOLDT, Ch. Engr., HAEGER POTTERIES, INC. Says: "The new Elgin Double Check Softener which replaced our old boiler room softener is most satisfactory. In addition to a large salt saving it gives over-capacity. It is self-cleaning and prevents zeolite loss."

FRANK A. ELL, Ch. Engr., STAR PEERLESS BREWERY, Reports: "Our Elgin Double Check Softener is at least 25% more efficient than the ordinary water softener. We are more than pleased."

CHAS. O. BRYANT, Supt., ALLEN & MORRIS, Tells us: "Two years ago we installed our first Double Check System. It proved so efficient that we have since equipped 11 more water softener units with Double Check Systems."

**GET THE DETAILS ON THESE OTHER BENEFITS THAT CAN BE YOURS WITH THE**

## DOUBLE-CHECK SYSTEM

1. Gives 25 to 35 per cent more softened water.
2. Prevents loss of zeolite.
3. Saves salt and furnishes more softened water per pound of salt than any conventional softener on the market.
4. Confines the zeolite mineral bed.
5. Gives increased capacity.
6. Eliminates packing, channeling and matting.
7. Faster backwash flow rates through the coarser zeolite.
8. Slower backwash flow rates through the finer zeolite.
9. Makes softener self-cleaning.

★

**WRITE FOR DESCRIPTIVE BULLETIN**

★

# ELGIN SOFTENER CORPORATION

**57 North Street, Elgin, Illinois**

SOFTENERS . . . FILTERS . . . FEEDWATER TREATMENT . . . CONTINUOUS BLOWDOWN . . . BOILER WATER CONDITIONING

*Preferred!*

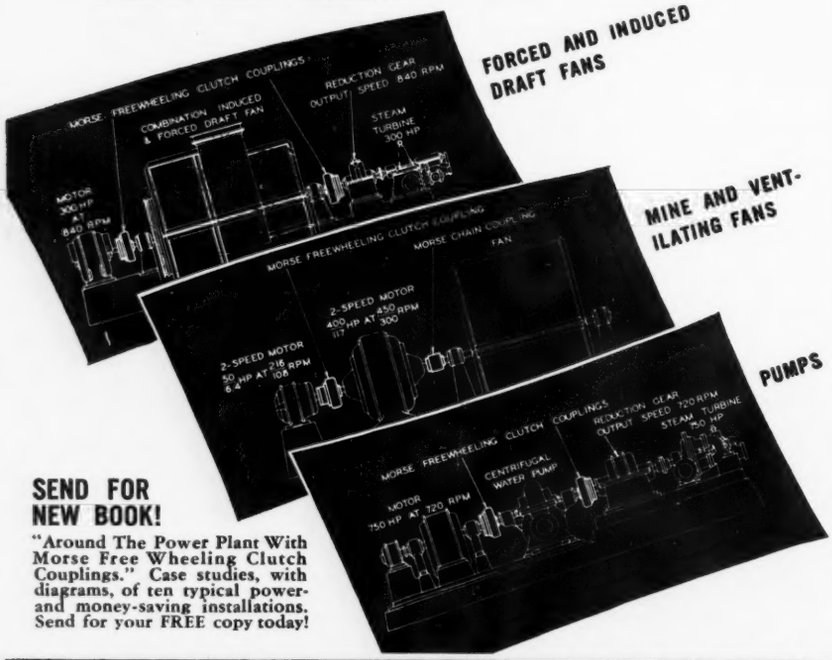
## Dual Drive operation simplified; stand-by power instantly available

THIS MODERN type coupling for connecting dual power units greatly simplifies the operation of power plant equipment; it is by far the preferred construction.

Morse Free Wheeling Clutch Couplings meet varying or constant speed requirements instantly without shock or danger to drives or driven units. A power deficiency in one unit can be made up smoothly and safely with the stand-by unit.

Morse Clutch Couplings reduce operating costs, repair and maintenance bills. They are fool proof, giving complete, automatic operation with safety.

For smoothest, simplest, most economical and most efficient team-work in dual drives, equip with Morse Free Wheeling Clutch Couplings.


FORCED AND INDUCED DRAFT FANS
MINE AND VENTILATING FANS
PUMPS
MORSE FREEWHEELING CLUTCH COUPLINGS
COMBINATION INDUCED & FORCED DRAFT FAN
REDUCTION GEAR OUTPUT SPEED 840 RPM
STEAM TURBINE 300 HP
MOTOR 300 HP AT 840 RPM
MORSE FREEWHEELING CLUTCH COUPLING
MORSE CHAIN COUPLING
FAN
2-SPEED MOTOR 400 HP AT 450 RPM 117 HP AT 300
2-SPEED MOTOR 50 HP AT 216 RPM 8.4 HP AT 108 RPM
MORSE FREEWHEELING CLUTCH COUPLINGS
CENTRIFUGAL WATER PUMP
REDUCTION GEAR OUTPUT SPEED 720 RPM
STEAM TURBINE 750 HP
MOTOR 750 HP AT 720 RPM

**SEND FOR NEW BOOK!**

"Around The Power Plant With Morse Free Wheeling Clutch Couplings." Case studies, with diagrams, of ten typical power- and money-saving installations. Send for your FREE copy today!

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS KELPO CLUTCHES

**MORSE *positive* DRIVES**

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.


with hollow cast-iron pistons sometimes used in reciprocating machinery.

I recall a case that happened a few years ago in which a hollow cast-iron piston exploded and killed the welder while he was depositing metal in a method similar to the one described in your article. They had been performing this operation for quite some time and no troubles had ever been experienced up to the time that the fatal accident occurred. Following this accident, extreme care was exercised to be sure to remove the screwed plugs, which are used to seal the piston after the core sand has been removed, in order to allow the expanding air to escape while depositing metal.

I thought this incident might be worth passing on as a reminder to those who might have occasion to deposit metal on hollow pistons.

*Jackson, Mich.* P M VAN WINGEN

## Money Talks

I have been interested in the discussion in recent issues of POWER on the subject of what constitutes real efficiency. A number of years ago it was impressed upon me that if the advantages to be derived from high efficiency can be translated into dollars and cents, the answer is easier for anyone to understand, because "money talks."

A number of years ago I recommended new electrical equipment for an industrial plant which would mean raising the power factor from 61 to 90, reduce the amount of power used, reduce peak loads, and save time on certain operations. All this tended to increase the general over-all efficiency.

The proposition was discussed in some detail with various executive officers, but no one got very excited over the proposed improvement. In discussing this with the plant manager, he suggested that these advantages of power-factor improvement, reduction in peak loads, etc, be translated into "dollars saved."

This made it necessary to study the power company's bonus rates for lower power factor and power rates; there also was a bonus for reduction in peak loads. There was also considerable money to be saved due to increased production.

The increased plant efficiency expressed in terms of total dollars saved was so impressive compared to the first cost of the new equipment that there was nothing further to be said. The dollar signs spoke so eloquently no one needed to say anything more.

*Schenectady, N. Y.* R F EMERSON

# ASK HERCULES:
## What did RPM DELO do under grueling tests?

**What Hercules Motors Corporation found out means money to you:**

With RPM DELO there was complete freedom from ring sticking in the severe full-speed, full-load tests as applied to Diesel engines in the Hercules laboratories. But, impressive as this is, it demonstrates only one of RPM DELO's superiorities. Over 100,000 hours of testing, in which many leading Diesel manufacturers took part, prove RPM DELO not only prevents ring sticking, bearing corrosion and sludge trouble—*but does all three for all Diesels!*

On top of this—cylinders, pistons and rings show a minimum of wear because of RPM DELO's unique ability to spread over hot metal surfaces and keep them lubricated. It never runs away from heat—never lets engine parts run dry.

Order RPM DELO for longer engine life, fewer overhauls, and higher operating profits.

**UNEQUALED FOR EVERY DIESEL**

**RPM DELO**
REG. TRADE-MARK
DIESEL ENGINE LUBRICATING OIL

**Order from Your Nearest Distributor as Listed Below:**

**IN THE UNITED STATES**

**RPM DELO:**
The California Company (Montana only)
Humble Oil & Refining Company
The Navy Gas and Supply Co. (Colo. only)
Standard Oil Company (Indiana)
Standard Oil Company of Nebraska
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

**Diol RPM DELO:**
The Carter Oil Company, Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

**Kyso RPM DELO:**
Standard Oil Company, Inc. in Kentucky

**Signal RPM DELO:**
Signal Oil Company

**Sohio RPM DELO:**
The Standard Oil Company (Ohio)

**IN CANADA & NEWFOUNDLAND**

**Imperial RPM DELO:**
Imperial Oil Limited

**IN BRITISH COLUMBIA & ALBERTA**

**RPM DELO:**
Standard Oil Company of British Columbia Limited

**THROUGHOUT THE WORLD**

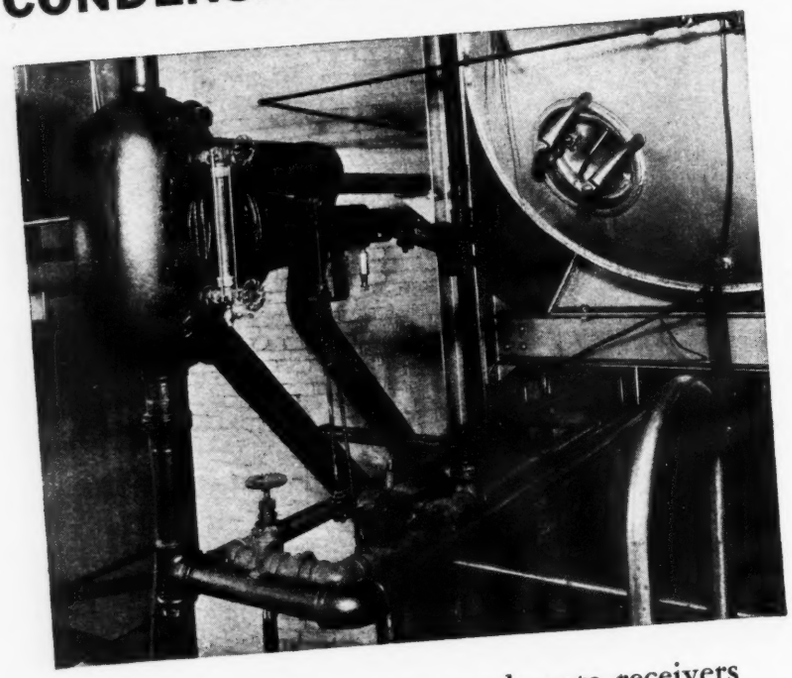
RPM DELO is available through distributors in more than 100 countries.

**STANDARD OIL COMPANY OF CALIFORNIA**

*For*

# Simple, Inexpensive

## CONDENSATE LEVEL CONTROL



Holding a safe level in condensate receivers is simple and inexpensive with Masoneilan No. 88 Level Controllers. These accurate, reliable controllers offer the advantages of low first cost, minimum maintenance expense and long, dependable service. Both controller and valve are built of most suitable materials, carefully processed and assembled to assure you more for your money. Write for your copy of Bulletin No. 88 which contains complete information.

The Masoneilan line contains equipment for the indication, recording and control of level in all types of vessels. Bulletins sent on request.

MASONEILAN
REG. U.S. PAT. OFF.

**MASON-NEILAN REGULATOR CO.**
**1186 ADAMS ST., BOSTON, MASS., U. S. A.**
Boston Buffalo Philadelphia Pittsburgh Chicago St. Louis Tulsa
Houston Los Angeles Mason Regulator Co. of Canada, Ltd., Montreal

## The Power Engineer Should Always Ask Why

Why? We encourage children to ask because they learn by asking. Our best engineers, even after they have learned lots and lots, are open to any and all suggestions and still ask why. One who knows things knows there is more to know!

Applied to condensers, this philosophy is an indication that many more improvements are possible, that some quite obvious items should probably be milestones of the past instead of still waiting to be recognized by future historians One of these is economy, within limits of being practical.

Why not welded-steel waterboxes for fresh-water service? Why not weld the return box of a 2-pass condenser permanently to the shell—tubes are always drawn from one end anyway? Why not steel tube sheets welded into the shell? Why not put manholes in the sides of the water box instead of in the head?

When you add these whys up, your condenser is as good or better than before—and it costs less to make. And besides it does not take an act of Congress or a 150-ton crane to get off a steel head.

In the condenser field today all manufacturers guarantee the same vacuum, condensate depression and deaeration of condensate, yet each has his own proven method of obtaining these results. What we lack is a determined buyer-engineer demand for progress. Such a demand would have brought welded-steel shells (or even riveted ones) over from marine practice years before one progressive concern actually had the temerity to build one for the public-utility field.

Did anyone who needs a condenser for a certain service ever sit down and ask a complete and definite reason for every part and detail of the design? Let it be forbidden to use a book, or what someone else said or did, or some past construction, as a valid reason. Why should the shell be a certain thickness? Why everything? When you think of shell plate, remember what a beating the thin plates of a destroyer take compared to the insignificant pressures a condenser has to stand. Then remember the 1½-in. thick cast-iron support plates you once bought—and paid for.

Remember, too, when a condenser was a shell with all the tubes one could get into it—about 2 sq ft per kw of turbine? Then came a new era when Paul Bancel led the march toward using half as many tubes to do more work? And Weir of Glasgow brought out wide-open steam spaces? Those were the days of flow and heat design; now we can turn to construction details of packing, stays, tubes, tube sheets, shells, support plates, water boxes, heads, bolts, collar bolts, manholes and gaskets. If you don't think there is much left to be done, just start asking the why of your next condenser all the way from the springs to the vacuum column.

*Indianapolis, Ind.* P R ELROD

ROBINS CONVEYING BELT CO, 15 Park Row, New York, has moved its offices from that address to new quarters at 270 Passaic Ave, Passaic, New Jersey. The New York sales office is at 70 Pine St.